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New Low-Cost
Digital Cameras

John C. Dvorak:
Littleton and the
Murder Programs
On Your Home PC

Trends:
MP3 Gets New
Competition in
Web Music

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- MetaCreations' Bryce 4
- ReplayTV and TiVo



THE INDEPENDENT GUIDE TO PERSONAL COMPUTING AND THE INTERNET

VOL.18 NO.12 JUNE 22, 1999

Future tech

**10
TRENDS**
That Will
Change
The Way
We Live
And Work

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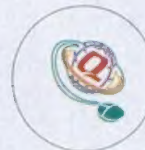
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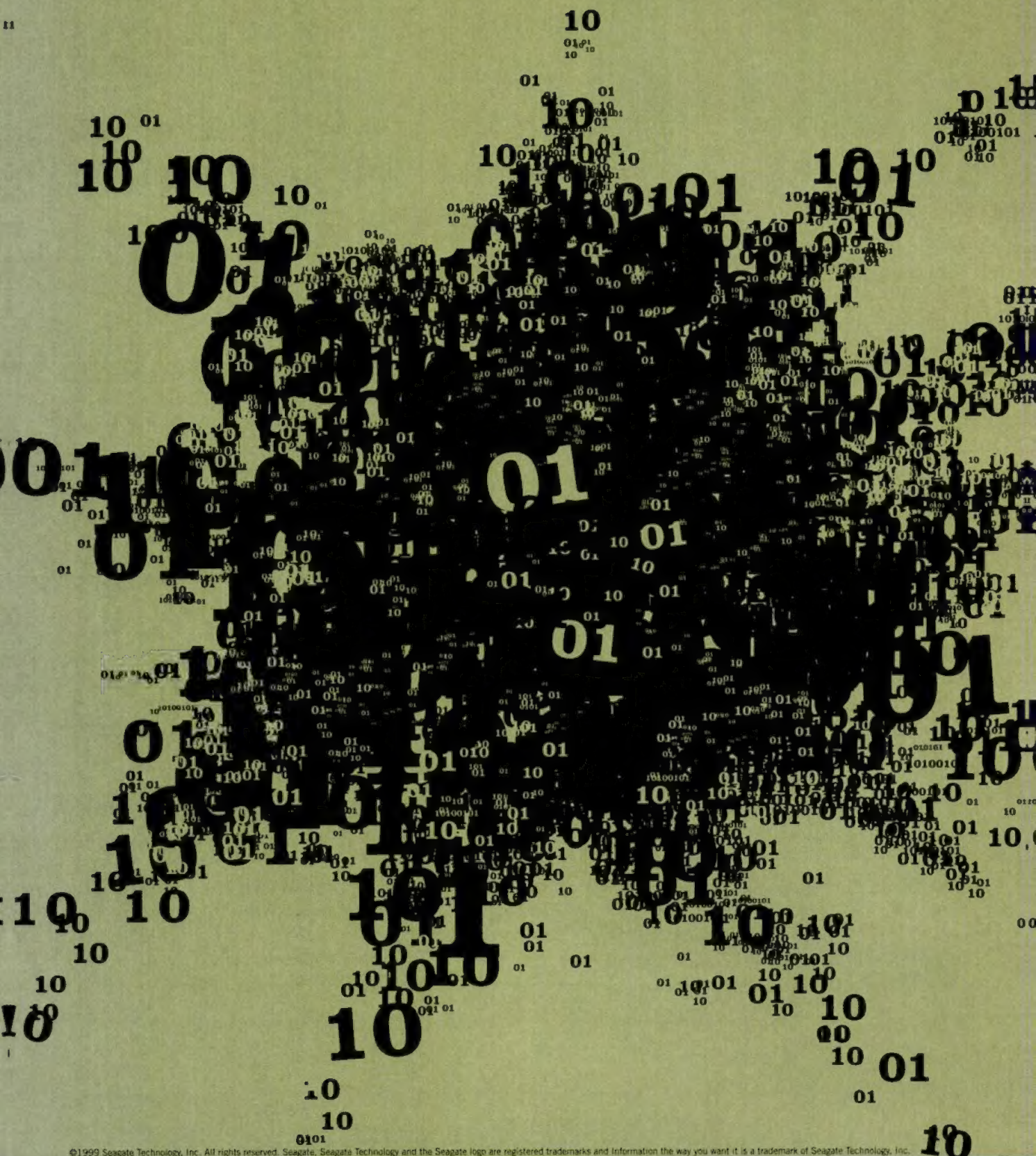
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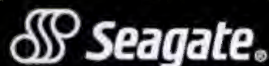
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Charting a Course

I guess it's just human nature. Everyone always wants to know what will happen next. That's why we all get together and speculate about which team will win the next game, what will happen next on our favorite TV shows, and which politicians will run in the next election. Thinking about the future is a

particular pastime for those of us who observe technology. We all want to know about the next great application or the next great device. I'm no exception.

That's why we pulled together this issue's cover story, which sets out the core trends we think will affect technology over the next few years (see page 100.) These trends cover everything from hardware to applications to communications. They won't all become mainstream products overnight, but they will change the way we use computers.

But it's one thing to identify trends, another to predict the future. I was reminded of that recently, when just after completing this cover package, I attended the 25th anniversary of the MIT Laboratory for Computer Science (LCS).

There, MIT speakers including LCS director Michael Dertouzos described an audacious plan called Project Oxygen. The idea is to have computers everywhere, just like the air we breathe. Individual professors and researchers described different parts of the concept.

On the device side, researchers showed the Handy 21, a prototype of a hand-held device that combines the features of a computer, PDA, and cell phone, among others. Another product was a wall-mounted appliance which connects such devices wirelessly. On the component side, researchers are working on a new processor architecture that changes the chip's functions on the fly. Voice recognition would control the system. It's a startlingly broad and ambitious project, and if it all works, it could redefine computing.

Of course, most of these concepts aren't unique. They fit well with the trends in our story, and with other research at other labs. But they also fit together well to create an interesting vision of the future, one in which technology surrounds us even more than it does today.

Things won't happen exactly that way, of course;

no research plan that ambitious will have only successes. Individually or collectively, efforts like this help define the way things will change. But almost nothing works exactly the way we think it will. No matter how much we plan, there's always the unexpected; something always comes along to change the best-made plans.

That's particularly true when it comes to technology. Sure, there are some things that can be predicted with a lot of confidence: For example, computers will get smaller, faster, and less expensive. But no matter how well you chart out Moore's Law or other technology axioms, they can never prepare you for the unexpected.

**There is one
thing we
can say
about the
future:
Expect the
unexpected.**

Various kinds of little computers were around for years, but it took the IBM PC to make personal computers a standard that businesses would adopt in large numbers. Xerox PARC and others worked on graphical user interfaces, but it took the Apple Macintosh to make the idea popular. The Internet was just for techies, and hypertext was an interesting but commercially unsuccessful idea, until folks like Tim Berners-Lee and Marc Andreessen created the Web and graphical

browsers, respectively.

Where will the next breakthrough come from? I can't answer that any better than you can. My guess is that it will come from some smart people who will take the trends we list here and combine them to create something no one is really expecting.

But the true breakthrough is never just pure technology. Rather, it is technology that gets applied in a way that changes how we live and work—the way computers changed how we write and budget our businesses, the way e-mail changed how we communicate, and the way the Internet is changing how we find information and buy and sell products.

One thing we do know: We will all be waiting for whatever the future brings. **PC**



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Cover: Illustration by Jack Harris, photography by Thom O'Connor



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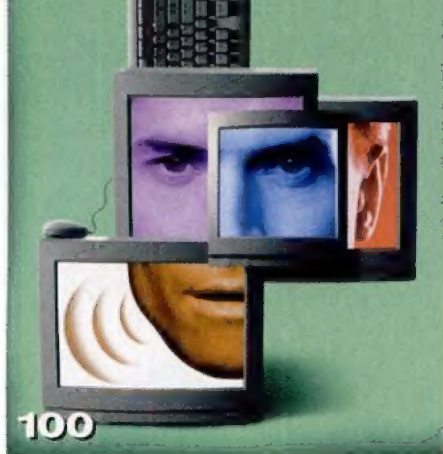
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COVER STORY

100 Future Technology

What technologies will have the greatest influence on computing in the next millennium? We've defined the ten trends that will change the future of computing. And we'll show you how you can try out some of these future technologies today.

Concept Computers: In this special foldout section, we look into the not-so-distant future and show you how researchers are rethinking the PC. *By Cade Metz Page 151*

PCs

160 Managed PCs

Today's corporate computers are more than simply the sum of their hardware parts: Manageability and serviceability add to the equation. PC Magazine Labs tests ten of the latest machines and puts the competing management packages through their paces. *By Cade Metz*

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189 Internet in a Box

Small to medium-size businesses interested in hassle-free Internet connectivity should look no further than the new breed of thin Internet servers. We review seven such devices and find them to be a cost-effective way of getting online. *By Robert P. Lipschutz*

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¹U.S. Dept. of Commerce "The Emerging Digital Economy," 1998. ²Life of fund is as of inception date: 2/4/98. ³Life of fund is as of inception date: 6/29/90. ⁴Average annual total returns include changes in share price, reinvestment of dividends and capital gains, and each fund's 3.00% sales charge and trading fee. Share price and return will vary and you may have a gain or loss when you sell your shares. All Select equity portfolios have a \$7.50 exchange fee and a 0.75% short-term trading fee on shares held 29 days or less. On shares held 30 days or more, the trading fee is the lesser of \$7.50 or 0.75%. Fidelity Distributors Corporation. 75782

Portable Music Revue

Consumer electronics companies didn't take too long to catch on. People don't want to download music from the Web and listen to it on their PCs. They want to take their tunes with them. Diamond Multimedia started the trend when it released the Diamond Rio PMP300 Portable Music Player last fall. At press time, at least six new portable players have been announced and are expected to hit the market imminently. Others are likely waiting in the wings.

Diamond Multimedia recently started shipping the Diamond Rio PMP300 Special Edition (\$249.95 list), which doubles the original Rio's 32MB of flash memory and is upgradable to 96MB. Diamond also re-designed the player with a translucent blue case.

One of the most anticipated players is the Creative Labs Nomad, a 2.5-ounce gadget that plays MP3 music files and includes voice recording, an FM tuner, and an LCD screen you can scroll to view artists' names and song titles. Available early this summer, the 32MB model (\$169.99) will store and play up to 60 minutes of music; the 64MB model (\$249.99) adds a 32MB flash card. A desktop docking station is designed to let you easily download music from your PC to the player. Creative Labs also launched a Web site, www.nomadworld.com

, which offers music and audio content as well as exclusive tracks from unreleased albums.

This summer, Samsung plans to introduce its diminutive Yepp (\$199), a 2.3-ounce MP3 player with 32MB of memory, an FM radio, a voice recorder, and a 500-name phone directory. An LCD will show song title, length, and lyrics.

Meanwhile, some developers are already branching out beyond MP3 by offering support for alternative digital music file formats. RCA plans to sell its Lyra digital music player, designed to play MP3 files as well as future audio formats. And e.Digital is manufacturing the first portable EPAC player; EPAC is a compression scheme developed by Lucent Technologies (see this issue's Trends section).

Web music players designed for the car are also likely to show up soon, including a version of the Yepp. This spring,

Britain-based Empeg plans to launch the Empeg Car, a removable MP3 player (and FM tuner) that slips in and out of a car's radio compartment. Serial and USB ports connect the unit to a PC for quick MP3 downloading. The unit can accommodate up to two 2.5-inch hard disks, providing up to 28GB of storage—about 500 albums. The 2.1GB (\$999) basic model stores and plays 35 hours of music.



Titans of Silicon Valley

Relive the early days of the PC industry, as Noah Wyle stars as Steve Jobs (left) and Anthony Michael Hall stars as Bill Gates (right) in "Pirates of Silicon Valley," airing on TNT June 20th at 8:00 P.M. How did the stars go about researching their roles? Hall says he spent six weeks studying Gates' biographies, interviews, and speeches. "There are so many aspects to his personality. I don't know if anyone can explain his work ethic. There's so much to him, and I had to look at him from lots of angles—as a CEO, as a public figure, as an industrialist, and as a technocrat."

Little Listeners

Engineers have long puzzled over the difficulty of making tiny microphones based on microscopic acoustic sensors. As reported in a recent issue of *Scientific American*, researchers are making significant strides in harnessing traditional microprocessor manufacturing methods to produce next-generation acoustic sensors.

At a recent conference in Berlin, Microflown Technologies announced the Microflown, a sensor that's etched into a silicon wafer and senses minute changes in heat as sound waves move through it. According to the company, Microflown sensors are able to work where heat, dirt, or vibrations would be damaging. Meanwhile, researchers at NASA's Ames Research Center have developed a prototype microphone that converts sounds into light patterns. Variations in the light are then converted into electrical signals.

Possible applications for minute microphones include smart cards that recognize their owners, voice activation of consumer products—from toys to household appliances—and biometric security devices. Other applications include minuscule hearing aids that are virtually invisible to the human eye, noise cancellation microphones, and ultrasonic cameras for murky underwater conditions.



Do Not Enter

Fifteen major Internet companies plan to deploy tools to limit children's access to Web sites that contain hate information, pornography, and other kinds of potentially objectionable content, in a far-reaching effort to police the Web content available to children. The effort comes on the heels of the shooting massacre at Colorado's Columbine High School.

Companies participating in the effort include America Online, AT&T, Lycos, Microsoft, and Yahoo! Each company will serve up links from its Web site leading to tools for monitoring Web sites children visit and for blocking some site access.

"There are some dark corners...free-fire zones, and red-light districts in cyberspace from which children must be protected," said vice president Al Gore in announcing the Parents' Protection Page program, which will go live in July.

Gore also said that although it may never be perfectly clear what prompted Eric Harris and Dylan Klebold to shoot other students at Columbine, "the Internet was a factor. I want to praise the Internet service providers for what you all are doing." He added, "There are others who have not come forward."



Storage Area Networks

An explosion of data is overwhelming corporate networks, and one of the latest solutions is the storage area network (SAN), a high-speed networking architecture based on centralized storage. SANs interconnect servers and data repositories at gigabit speeds and provide a single point of storage accessed by multiple servers.

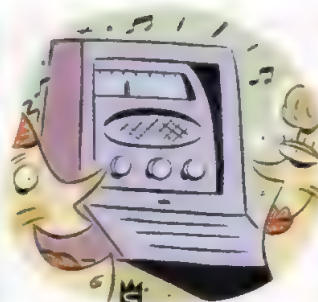
Some of the big players include Data General's Clarion, Compaq, Dell, EMC, Gadzoox Networks, Hewlett-Packard, and IBM. Microsoft is also positioned to stir up the market when it releases the SAN-friendly Windows 2000. "Every piece of data, every mouse click creates information that e-commerce companies need to keep. They don't want to lose any of it. They want to be able to go back five years and analyze every bit of information they collected in order to fully understand their market," says Larry Thomson, a vice president at EMC.

But questions remain about the cost of implementing a new architecture. Most companies have very costly networks already installed, and they're not likely to toss them aside. SAN providers meet this criticism by stating that SANs will be complementary to existing server-based storage systems, not direct replacements.



Source: GartnerGroup/Dataquest, 1999

THIS ISSUE'S CONTRIBUTORS: Carol Levin, Sharon Nash, Sebastian Rupley.



Web Radio

Only weeks after acquiring streaming-multimedia content provider Broadcast .com for over \$5 billion, Yahoo! is preparing to deliver Yahoo! Radio (radio.yahoo.com). Based on technology from Spinner .com, Yahoo! Radio will offer a series of music channels, including Alt.Rock, Y! Jazz, Y! Classical, and Y! Country.

Currently in public pre-release, Yahoo! Radio's official launch this summer will follow in the footsteps of the Lycos Radio Network (radio.lycos.com), which is already up and running. Other players have recently entered the Web radio scene as well. Viacom recently acquired Imagine Radio and plans to produce a Web music site. Down the road, Web radio sites may offer other forms of audio content, such as corporate presentations, educational lectures, and sports events.

Web-based music in general has taken off dramatically. RealNetworks recently reported one million downloads of its RealJukebox player.

Top-Selling Retail Notebooks

1	IBM ThinkPad 800 (\$2,853)
2	Toshiba Satellite 2535CDS (\$1,313)
3	Compaq Presario 1255 (\$1,367)
4	Compaq Presario 1260 (\$1,612)
5	IBM ThinkPad 1471 (\$1,553)
6	Compaq Armada 3500 (\$2,549)
7	Toshiba Tecra 8000 (\$2,565)
8	Compaq Armada 7400 (\$2,657)
9	IBM ThinkPad 360Z (\$2,291)
10	Toshiba Portege 7010 (\$2,734)

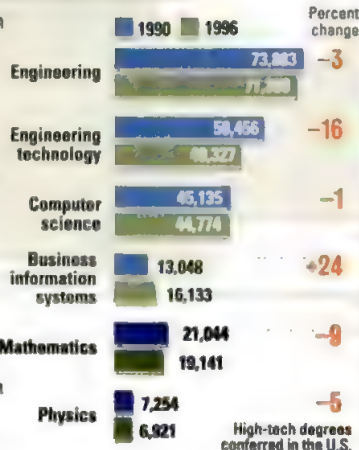
Source: ZD InfoBases, April 1999

Web Ad Surge

Internet ad revenues more than doubled in 1998, according to a report conducted by the New Media Group of PricewaterhouseCoopers for the Internet Advertising Bureau. Reaching \$1.92 billion in 1998, ad revenues grew by 112 percent over the previous year's total. Banner ads remained the most popular, followed by sponsorships and pop-up ads. Consumer-related companies accounted for 29 percent of ad spending, with financial services at 19 percent, telecom at 8 percent, and new media at 7 percent.

C- for Cybereducation

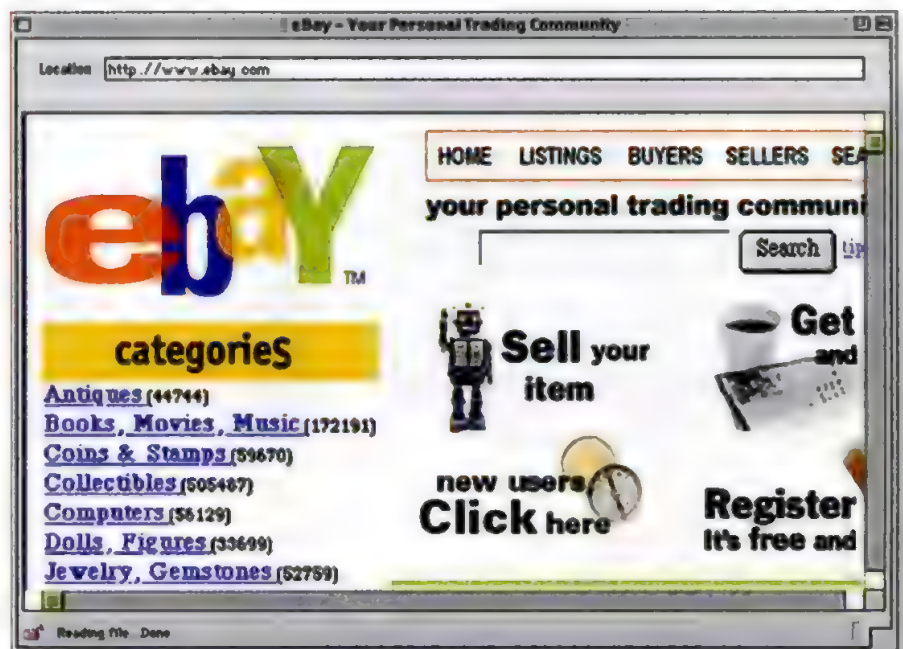
The number of high-tech degrees declined an average of 5 percent from 1990 to 1996, an indication that the U.S. educational system is not adequately preparing youths for today's information-age economy, according to a new study from the American Electronics Association. Today's high-tech labor market has extraordinarily low unemployment rates, the result of fewer students receiving tech degrees, coupled with the relentlessly growing industry.



Source: American Electronics Association, 1997.

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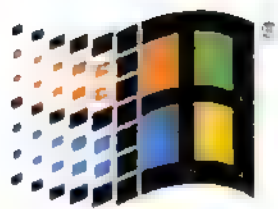
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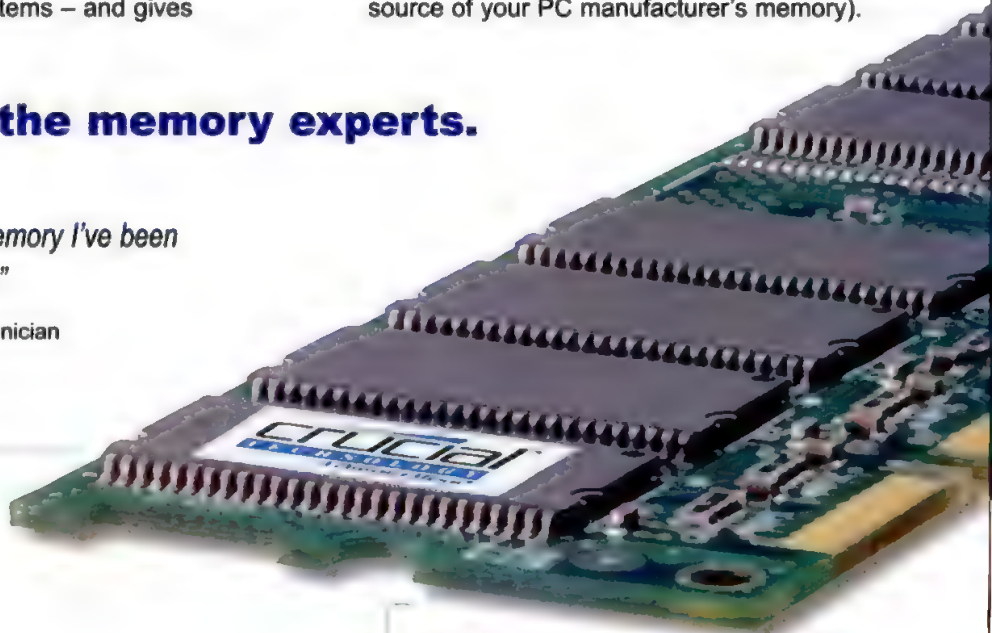
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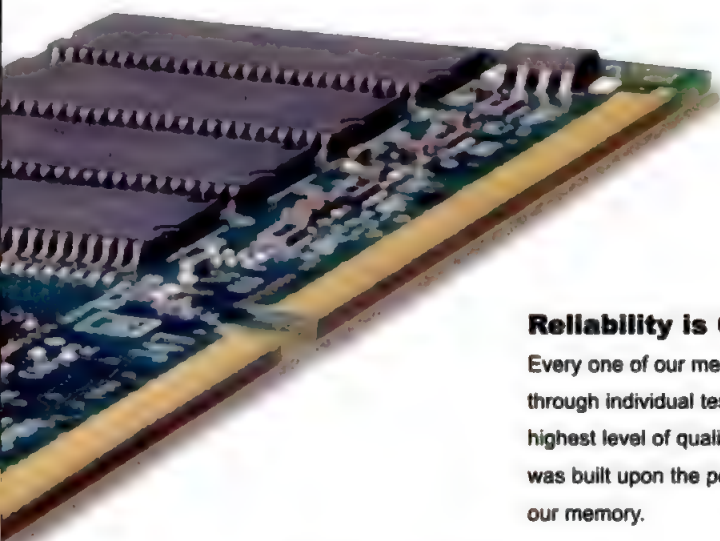
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LETTERS

THE 1999 UTILITY GUIDE

Nice, informative article about antivirus programs ("Defend Your Network," May 4). But can you tell me why I should upgrade my current versions of antivirus programs to the newest versions of the same products? I apply the latest virus definition files to my existing versions; isn't that good enough? Would I truly be getting a better virus scanner with the new versions—or just getting bloatware (like the latest versions of so many other genres of software programs)? In that case, "if it ain't broke, don't fix it" might be a more prudent approach.

LAWRENCE GOULD
via the Internet

Keeping your antivirus program up to date is the key to effective protection from computer viruses. But virus definition files or signature files—the telltale signs of a computer virus—are only one of the kinds of components that you need to update on a regular basis. You also need to update the virus scanning engine so that it is equipped to scan for the latest viruses. With most programs, the only way to get the latest scanning engine is via a separate download or complete program update. Finally, like all types of software, antivirus programs acquire new features with each release. So first and foremost, make sure you download the latest definition files. But also evaluate each new version of your antivirus program as you would any other type of software.—Ed.

When I saw the article "Defend Your Network," I thought I'd finally found an article on how to protect PCs and networks from online intruders, but of course the article was concerned with antiviral tools. I understand that your magazine is geared mostly toward corporate PC users, but I'd like to see an article focused on how to protect your home PC against hackers.

I work in the computer field, both as a trainer and as a Web designer, and lately I've seen a rising number of cases in which computers have been infected with "Trojan horse"

viruses, such as Back Orifice and NetBus. I've done a lot of research into the subject and discovered that this problem is widespread, and the incidence of infection of personal PCs and corporate LANs is increasing.

My concern is that most people don't know about the threat of these Trojan horses, and those who do don't seem to know what to do to protect themselves. I've found a few programs that offer some protection. But although I work in the computer industry, I'm not completely confident that my own solutions are adequate. How about running an article about these viruses, accompanied by reviews of programs that can protect users, such as PC firewalls and port listeners?

TERRY M. ATKISON
via the Internet

"I apply the latest virus definition files to my versions; isn't that enough?"

We agree: Those other security products are also important. And you'll see comprehensive coverage of both personal and corporate security products in the very near future. So stay tuned.—Ed.

Although Fix-It Utilities 99, from Mijenix, was just released in late March, you missed a keeper (www.mijenix.com). I have been an avid fan of Norton utilities since the early years, but Mijenix has now beat them by a mile. The product's functionality (it works with Windows 95, 98, and NT) and the included PowerDesk98 really make Fix-It Utilities 99 shine.

ALLEN WALKER
Evergreen, Colorado

Mijenix's Fix-It Utilities 99 is indeed a promising new entry in this category. Unfortunately, it was not completed in time to be covered in our story. But for a complete review, see First Looks at our Web site (www.pcmag.com) or in our June 8 issue (page 60).—Ed.

PC Magazine undercut its reputation as a thoughtful magazine with the following statement in its review of corporate monitoring and filtering utilities ("Make Net Work, Not Play," page 189): "Although prohibiting pornography and hate speech is a no-brainer (not doing so can leave corporations vulnerable to possible sexual harassment and discrimination suits), companies are also concerned with the effect of unlimited surfing on productivity."

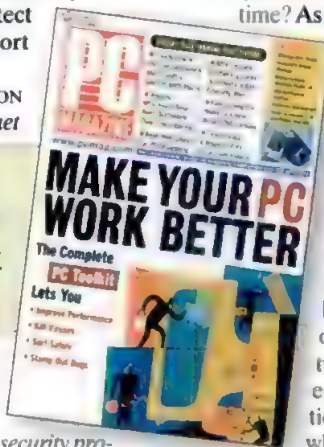
First, I have yet to hear of a single corpora-

tion being sued on the basis of providing *too much* access to the Internet. The Web isn't push technology, and no one is forcing employees to seek out its darker side. Those who do—in such a manner as to cause other employees discomfort—can be dealt with by human resources departments in the same way any other harassment would be.

As for "the effect of unlimited surfing on productivity": Several filtering vendors I have talked to admit that most employees who are blocked from a site will spend an inordinate amount of time banging on the filter, trying to beat the system. Is this a productive use of time? As far as employee productiv-

ity goes, the Internet is no different from telephone use. Employees who spend all day on the phone chatting with friends won't get their work done, and companies know how to deal with that problem: It's called *firing*. The real issue here is maintaining a level of trust and respect between the employee and the employer, enforced by traditional means of termination when work doesn't get done.

LARS KONGSHEM
via the Internet



YOU'D BETTER SHOP AROUND

As an owner of a retail computer store, I must comment on your recent Site Finder article "PC Shopping" (May 4). You stated that "one of the best reasons to buy a PC directly from one of the major vendors is that they typically provide a much higher level of service and support."

Many customers come to my store frustrated and upset because they bought PCs from major vendors only to find that when they need support, they spend hours on the phone with unqualified technicians. Most PC helpdesk personnel do nothing but read from a "cookbook" designed to troubleshoot problems; when the problems do not follow the rules (and typically they don't), the help desk is at a loss.

You emphasize that major vendors offer technical support via their Web sites, but the most common failures render your PC unable to function, much less get on the Internet. These Web sites are good for software updates but are totally useless for troubleshooting PC hardware problems.

Our store's average turnaround on a PC repair is next day or sooner. Not even the major vendors can come close to that. Many smaller companies provide superior service and com-

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Piranha, pi-ran'ya, n. A small, voracious freshwater fish that will attack any sized opponent, no matter how large.

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so we have to
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5330

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SAMPLE SERVERS



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- Dual PCI Buses 166MHz PCI Support
- Integrated Adaptec Ultra2 LVD SCSI
- Integrated 10/100 Ethernet
- Integrated 2MB Video
- 9GB LVD 7200RPM Remov. HD
- 1 Channel LVD RAID
- Sony 32X CD-ROM/Max
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SAMPLE RAID SUBSYSTEMS



STC 10 BAY

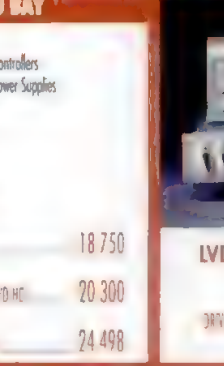
- 2 Channel RAID LVD U2W Controller
- 10 Hot-Swappable Drive Bays
- Redundant Power Supplies
- 16MB Cache
- Internal Temperature Status
- Power Supply Status
- Cooling Fan Status
- Visual and Audible Alarm

Q (3) 36GB 7200RPM LVD HD **8825**
Q (3) 18GB 10,000RPM 5.0ms LVD HD **7928**
Q (3) 9GB 10,000RPM 5.0ms LVD HD **6458**

STC 20 BAY

- Active Active Controllers
- Q (2): 4 Channel RAID 5 U2W Controllers
- 8 230 Watt Hot Redundant Power Supplies
- 128MB of Cache
- Internal Temperature Status
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- Cooling Fan Status
- Visual and Audible Alarm

72GB Solution
Q (8) 9 1GB 7200RPM LVD HD **18 750**
72GB Solution
Q (8) 9GB 10,000RPM 5.0ms LVD HD **20 300**
144GB Solution
Q (8) 18GB 10,000RPM LVD HD **24 498**



LVD STORAGE SOLUTIONS

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- Redundant Power Supplies

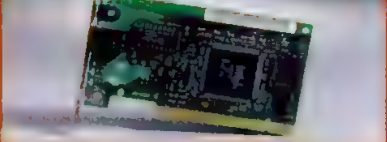
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- 36GB 18GB 9GB LVD SCSI Drives

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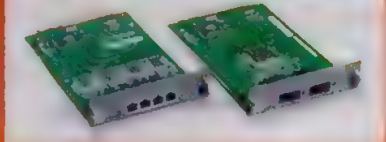
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JEFF HOLDER
Escondido, California

Having spent much time over the past two months shopping the Web for a new computer, I generally concur with your article. I would have ranked Quantex's site as superior to that of the other major vendors, though, for the flexibility it offers in comparing different systems, as well as the range of systems it offers. The one gripe I had with all the major vendors is that none of them truly let you build your own system. Although they offer options, there are limitations to what you can build, some of which make no sense. For example, neither Dell nor Quantex lets you have a hardware modem installed in a Pentium III computer. The only vendor I found that lets you really build your own is Zenon (www.zenotech.com): You choose every component, from the motherboard to the mouse.

CHAYIM LANDO
Los Angeles, California

E-COMMENTS

In his column "The D-Word and the Web," (May 4), Jim Seymour discusses e-commerce. The word *disintermediation* sounds like something cooked up by a Pentagon spin doctor. Harry Truman put it more simply: "The buck stops here." More often than not, when shopping on the Internet I have no easy way to determine where exactly my buck (or should I say *e-buck*) will come to rest.

I recently bought a flowering bromeliad through my ISP, which hot-linked me to a major online florist.com. The financial transaction was handled by another dot.com. The order was filled by a greenhouse in California, which contracted out to another greenhouse in Texas. For customer service, I was referred to yet another dot.com. It took eight weeks to fill the \$36 order. The ironic part: I found out I could have bought the very same plant from my local supermarket's floral department for only \$5.99.

Give me a retail store where I can inspect the merchandise and where I know the buck stops regarding purchase and customer service.

BRIAN M. KOCHERA
via the Internet

ROAD WARRIORS

Although your article on ISPs was informative and useful ("At Your Internet Service," April 20), it did not cover tips and advice for the road warrior who travels out of the U.S. In the international arena, only a handful of ISPs provide access to their networks primarily through local dial-up numbers. If you subscribe to a regional ISP, e-mail access will most likely mean a costly IDDD (International

Corrections and Amplifications

In our May 4, 1999, story on desktop antivirus programs (part of "The Complete PC Tool Kit"), the review of Panda Software's Panda Antivirus Platinum incorrectly described the results of our performance tests. Like the other eight products in our review, Panda Antivirus did disinfect all ten of our test documents that contained macro viruses; our review stated incorrectly that Panda Antivirus failed to disinfect four of the test documents. In fact, in these four instances, the program actually removed all macros, including legitimate user macros. Our performance test sidebar (page 116) correctly summarized these results.

In our story "LCD Monitors" (April 20), we incorrectly reported that the IBM T55D and the Sony CPD-L150 can pivot between portrait and landscape modes. While the mounting plate on the back of each unit lets you mount the monitor in either portrait or landscape orientation, the bases do not let you swivel between modes, nor is software included to enable the pivot feature.

Distance Direct Dialing) call. Sad to say, the ISPs I have called for information are not knowledgeable about this. I have been trying to sign up with a local ISP with access to the GRIC (Global Reach Internet Connection) for the past year without success.

JONATHON CHEAH
via the Internet

I have traveled with my laptop on seven business trips to Berlin since 1997, and I know you could write a book of tricks and tips for American laptop owners who travel abroad. I hope *PC Magazine* will address these issues. Here's a list of possible topics for stories: global modems, plugs and adapters for power and telephone in foreign countries, country-specific tips, hotel telephone setup steps, pre-trip checklists, ISP policies for foreign connections, and comparing vendor/supplier policies.

PETER SONNENTHAL
via the Internet

This is the kind of information we try to provide in our annual "Road Warriors' Guide." You can find it online at www.pcmag.com/special/roadwarrior/open.htm, and be sure to check our upcoming August issue for an updated version.—Ed.

WHOSE BIOS IS IT ANYWAY?

Benjamin A. Rudnick (Letters, May 4) thinks the Compaq Deskpro's proprietary BIOS is great for the corporate environment, because hard disks are the most likely components to fail, and you'd always have another Deskpro available. Well, I don't know what corporate environment he lives in, but all the ones I've known have had a variety of computers, not just one brand. Sure, they might buy one model at a time, but they don't replace all the computers at the same time, so any one model is in the minority. Besides, if your proprietary hard disk fails, why would you need another Deskpro? If the drive's dead and the data's lost, you could use any computer as a replacement. The problem is that if your computer fails but the data on the hard disk is good (a common occurrence), you'd want to move that drive (or at least the saved data) onto another computer and just keep on working. Your Deskpro drive would work only on an-

other Deskpro, and what's the chance there's a Deskpro sitting unused, waiting for a hard disk to be installed? The spare computer that would land on a user's desk to replace the dead Deskpro would likely be a lower-end, cobbled-together, Frankenstein machine, or maybe an old castoff that's seen better days. Not the best way to do things.

DONNA CURRIE
via the Internet

START ME UP

Your utility Startup Cop is really cool ("Manage Your Start-Up Programs," Solutions, April 20). A programmer friend and I were just discussing the problems we are always having with the programs in our Startup folders. Although we knew we could manually disable them, we were afraid to do so, because we weren't sure how this would affect our machines. Startup Cop resolved our problem perfectly. Everyone else must think it's cool too, because downloading it took me forever!

TRAVIS MURDOCK
via the Internet

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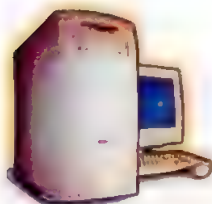
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Opening on side makes servicing Equium[®] easy

BY MICHAEL CATON, PC WEEK LABS

THE SIDE DOOR ON THE EQUIUM 7000S desktop PC is one of those small features that works so well that it's a wonder no vendor thought to include one like it before.

The side door on Toshiba America Information Systems Inc.'s \$1,714 computer is designed to make



The Equium 7000S allows easy inside access.

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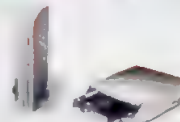
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Manageability Hardware Extensions	Integrated internal temperature and voltage sensors Chassis intrusion alert
DMI 2.1	Yes
Intel LANDesk Client Manager	PC health monitoring, hardware inventory, software inventory, remote management
Year 2000 Compliant	NSTL hardware tested
Wired for Management (WIM) Compliant	Yes
Software FIX THEMSELVES ???	Intel LANDesk Client Manager, Expert Intelligence Help, Toshiba Configuration Builder, SMS Connect
Processor CPU	Intel Pentium® III processor, 450MHz or 500MHz (with 512KB cache) Intel Pentium II Processor, 350MHz, 400MHz or 450MHz (with 512KB cache) Intel Celeron® processor, 333MHz, 366MHz, 400MHz or 433MHz (with 128KB cache)
Memory Maximum	32MB, 64MB, 128MB or 256MB SDRAM 512MB
Bus speed	Matched with CPU Bus Speed

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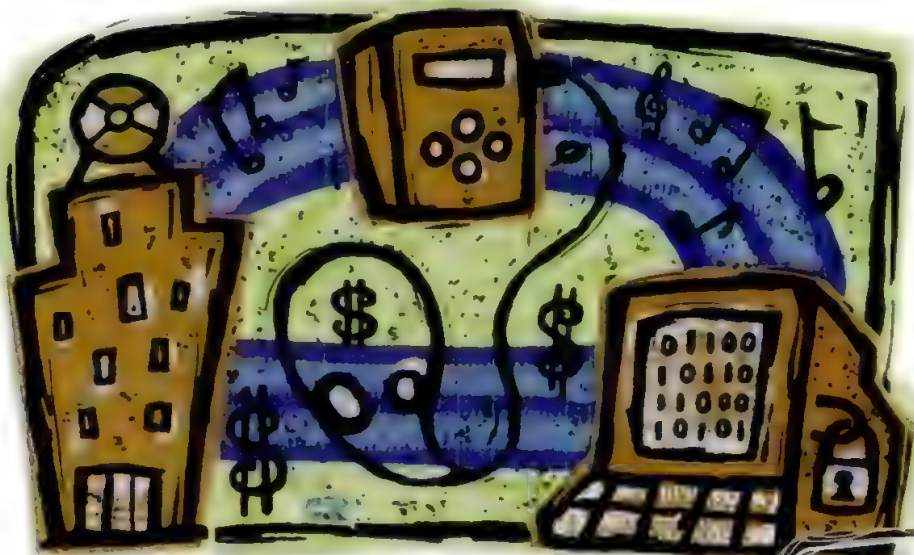
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Let the Music Play

Gearing up for a very digital holiday shopping season.



You don't have to be David Geffen to see that the delivery of music over the Web is a potential gold mine for music companies. The music business pulled in \$12.8 billion in 1998, but only 1.5 percent of transactions were online. That number is expected to rise to 10 percent by 2003, according to market research firm Cyber Dialogue.

So far, though, few record companies have made even a penny online. And they're just now recovering from the shock and confusion that hit when MP3 made its debut, starting a digital stampede to upload, share, and download music (sometimes illegally) over the Web. Then the Diamond Rio PMP300 Portable Music Player appeared, enabling music fans to listen to free downloaded tracks, independent of their PCs. Now there's no going back. Will the Web's killer app kill the record industry?

"The idea that record companies are going away is absurd," says Brian Brinkerhoff, vice president of content acquisition at GoodNoise, an MP3 site. MP3 plays havoc with the manufacturing and distribution roles of record companies but not the recording and promotion roles. "The music industry shunned digital distribution, but the effect was to cut itself off from potential customers in the name of pro-

tecting intellectual property," says Scott Reents, analyst at CyberDialogue.

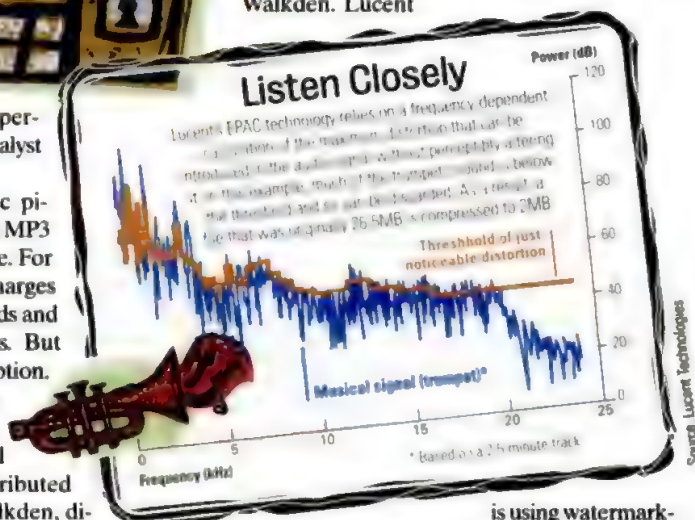
The Web is a music pirate's paradise, but legal MP3 sites do exist, of course. For example, GoodNoise charges customers for downloads and pays music publishers. But GoodNoise is the exception. "People who own this content have a very real reason to be afraid of how content is distributed now," says Rachel Walkden, director of audio at Lucent Technologies' New Ventures Group.

In response, the Secure Digital Music Initiative, which includes the top five record companies and 120 technology companies, is hammering out a framework for digital rights management to ensure that artists and record companies get royalties for online sales. Compliant portable players and music to play on them should be ready for the 1999 holiday shopping season (see this issue's Pipeline). "The availability of millions and millions of recordings will turn this into a very robust distribution channel for the record industry,"

says Larry Miller, CEO of a2b music.

Recognizing potential problems retrofitting MP3 with security features, companies are developing MP3 alternatives that have security built in from the get-go. Lucent has introduced a secure alternative to MP3 known as Enhanced Perceptual Audio Coder (EPAC), which is designed to compress audio at 11:1. So for every 11 bits thrown away only 1 is kept. "That 1 bit is the DNA of the music," says Walkden. Unlike an MP3 player, which you need to download and install, an EPAC player can be delivered automatically when you click on a song title. Not to be left behind, Microsoft recently introduced its own codec, MSAudio 4.0, which the company claims downloads music in half the time and requires half the storage of music compressed with MP3.

The essence of the debate isn't about sound quality or compression efficiency, however, but digital rights management. "Copy management isn't a bad word," says Lucent's Walkden. Lucent



is using watermarking and encryption technology from Cognicity. a2b music uses PolicyMaker, an AT&T technology for license authoring. Microsoft recently partnered with Reciprocal, a developer of digital rights management software. And music giant Universal Music Group recently partnered with InterTrust, a developer of digital rights management software, to expedite trials of online music distribution.

Whether the winner is EPAC, MP3, MSAudio, or something else is almost a nonissue in the long run. "Consumers don't care about technology," says Miller. "They care about music, and lots of it." —Carol Levin



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The New Dukes Of Domains

What's in a name? As far as Web domain names go, this is a multiple-choice question.

A consortium of Internet and telecommunications companies have announced that in late June they will start competing with Network Solutions, which was the sole provider of domain names, such as *www.zdnet.com*, on the Web. Because the arrival of the new consortium will represent the first time anyone has competed with Network Solutions, the development is expected to result in lower prices for those who register Web addresses. Network Solutions charges \$70 to register a typical domain name for two years, but competition could bring such costs down quite a bit.

The companies making up the initial consortium—America Online, France Telecom, the Internet Council of Registrars, Melbourne IT, and Register.com—will have some stumbling blocks. One is that Network Solutions operates the primary existing database of domain names, and the new competitors will have to pay Network Solutions to list addresses in the database, in accordance with U.S. Department of Commerce policy. In addition to the 5 core members of the new consortium, there are 29 other parties waiting in the wings to join.

The initial fee for registry listings will be \$18 per address, and Network Solutions is allowed to charge a one-time fee of \$10,000 when one of these new entrants connects to the central registry. The Internet Corporation for Assigned Names and Numbers is a nonprofit group designated to oversee the new entrants to the domain-name game.

The transition to a more open process for registering domains has been a subject of hot political debate since 1996, when e-commerce started perking up.—*Sebastian Rupley*



The Not-So-Managed PC



You're sitting at your workstation and need information about the company's networked PCs. You open an application and retrieve hard disk sizes, BIOS and driver revisions, and memory configurations. Then you check for any signs of imminent drive failure. It all happens through one application and works for all PCs regardless of make or model.

Given the current state of network management tools, this scenario is pure fantasy. In this issue, PC Magazine Labs evaluated the management capabilities of the ten leading corporate PC vendors. The results were disappointing. DMI (Desktop Management Interface) 2.0 was released in April 1996, promising a standard way for sending management information across the network to a central site. But in three years, the industry hasn't yet reached an all-encompassing standard.

The management software installed on our test systems—Compaq's Insight Manager, Dell's IT Manager, Hewlett-Packard's TopTools, IBM's Universal Management Agent, and Intel's LANDesk Client Manager—is designed to help inventory and monitor systems on small to midsize Windows networks. These tools adhere to standards such as DMI 2.0, but they don't work together.

Although Compaq, Dell, HP, and IBM have developed sophisticated management software with such features as remote driver updates and BIOS flashing, interoperability remains problematic. In fact, except for HP's, these software packages don't recognize systems from other vendors. Although these vendors lead you to believe that their systems can interact with any DMI 2.0-compliant PC, that's just not the case.

Compaq, Dell, and IBM systems can manage and be managed using their own dedicated hardware and software; the HP system can interact with all the others. Systems with Intel's LANDesk can interact with other LANDesk clients but not with systems from Compaq, Dell, HP, or IBM.

For now, all management software is based on DMI 2.0, but other standards are on the way. Intel's Wired for Management (WfM) specification combines DMI 2.0

in order to inventory hardware. Wake on LAN 2.0 to power up desktops remotely. Advanced Configuration and Power Interface to reduce power consumption, and Preboot Execution Environment to load an operating system from a remote boot server. With a WfM-compliant system, you're guaranteed at least this level of management capability.

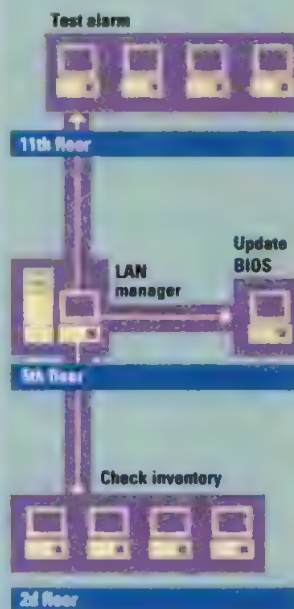
Web-Based Enterprise Management (WBEM) is another management standard. Originally from Microsoft, it's a programming interface now handled by the Distributed Management Task Force for managing networks and systems via the Web. Except for Intel's LANDesk Client Manager, all the products are Web-based and have browserlike interfaces. WBEM uses the Common Information Model

(CIM) for storing information. WBEM and CIM will let vendors use just one set of data definitions to describe their products.

For the managed PC movement to catch on, the industry still has plenty of work ahead of it regarding interoperability and ease of use. Standards such as WfM and WBEM are positioned to move the industry in the right direction. For now, though, your choice for centrally managing your network is to use multiple management packages or none at all.—*Rich Fisco*

Troubleshooter

Compaq, Dell, HP, and IBM have developed sophisticated software that lets network managers maintain systems remotely (below). But interoperability remains problematic. If you have machines from several vendors, one management program just won't cut it.



SECURITY

Safety in Random Numbers

Pick a number, any number. Got it? Whatever number you picked, it's not really random, because psychological factors come into play. Ask a computer to pick a random number and you've stumped the computer. Although the result may appear to be random, it's actually a pseudo-random number generated by a calculation such as the Lewis-Goodman-Miller generator: $x_n = 16,807 \times x_{n-1} \pmod{2^{31}-1}$.

This means that over time, a pattern will emerge in the numbers a computer picks. And that can cause trouble.

Random numbers are fundamental to computer security, because they're used to generate security keys that prevent crooks

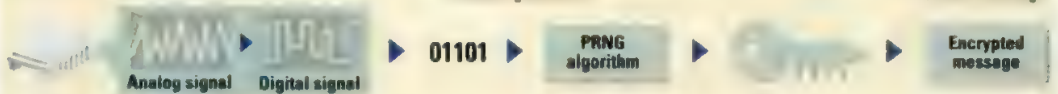
from breaking into online bank accounts, compromising online transactions, and snooping into digitally signed documents. Given enough time and money, it's possible

1 The Intel Random Number Generator produces random bits

2 These bits are used to seed a pseudo-random number generator.

3 The output creates a key of 40 to 128 bits.

4 The key encrypts and sends a secure message.



Only a few natural events are truly random, such as radioactive decay, fluorescence, electron spin, and thermal noise. Intel's Random Number

Generator harnesses the thermal noise produced by a resistor to generate random numbers, making encryption keys and security protocols more secure.

to trace a pattern and replicate a key.

To help solve this problem, Intel security experts have developed a random number generator that harnesses thermal noise—one of the few sources of random and indeterministic phenomena—to generate a ran-

dom number, which is used as an input to produce secure keys. Thermal noise is produced when a chip's resistor heats up as it's being used. The temperature the resistor radiates varies over time, driven by minute variations in airflow. Hardware-based random number generators are available now, but they're bulky and expensive. Intel's efforts represent the first time a hardware-based random number generator has been produced in high-volume on a standard component. Intel expects to include the random number generator in its 810 chip set, which will be used in mainstream desktops.—Carol Levin

My Technological Life, and Welcome to It

When it comes to the future, sign me up. I love the future. And not just the personal jet packs, embedded biometric microchips, and zero-gravity toilets that certainly await us. Even the amazing advances in personal computing you can read about in this issue's cover story pale in comparison with the thing I like most about the future: By definition, the future works.

When we envision the millennium-busting technologies of the years ahead, we describe them as working with complete reliability, unlike today's versions, which disappoint as often as they thrill. Take my life, for instance.

I'm in the middle of a technology-challenged month, beginning when the New York state tax authority's online return system refused to accept my form as submitted but couldn't explain why. My only recourse was to keep changing numbers randomly and resubmitting the form until the computer deigned to accept it.

Then there was our move to new offices here in New York. We transferred the better part of 1,000 people, including their belongings, networks, and computers, with hardly a blip in productivity. But there were those little annoying technical glitches that seemed to add up hourly.

I arrived at the new digs the first day to find that the lobby security gates rejected my new electronic, bar-coded security ID card. Once I managed to get to my floor, I found my office marked by a nicely printed name plate, but my name was misspelled. Neither of my computers could access our network, and the voice-mail system denied me access. The instructions for accessing it were sitting

inaccessible in my e-mail box. Turns out not only were they inaccurate but they contained a virus as well.

Thanks to the fast work of our infrastructure staff, who had spent many nights and weekends on the move, the problems were cleared up quickly, reinforcing the point that it's people who make or break technology. In the future, no doubt our technology will work without constant human intervention.

Today, sometimes people can't make technology work no matter how hard they try. Take, for instance, DLJ Direct, the online brokerage service retained by ZD to handle employee stock purchases. Somehow DLJ managed to open two accounts in my name rather than the anticipated one. Despite lengthy phone conversations with seven DLJ representatives—and counting—my stock information continues to reside in one account while the record of my payment for said stock resides in another. The efficient brokerage's computers continue to issue e-mail and mail-gram demands from the first account demanding the money that sits a few digital feet away.

Other recent candidates for hapless technical implementations include Microsoft Expedia, which let us reserve airline tickets online but wouldn't release the tickets for some unexplained reason until their price had doubled. And I'm still peeved at United Airlines: Its Web site lets you register online but makes you wait until your access code arrives a month later via snail mail. The code didn't work, and the Web site instructed me to request a new one, again to be delivered by mail. I've been trying to use the system since January.

Suffice it to say that I'm really looking forward to the point in the future when all these great products and services do work flawlessly. I know they will. That's what the future is all about. I can't wait.

Jake Kirchner

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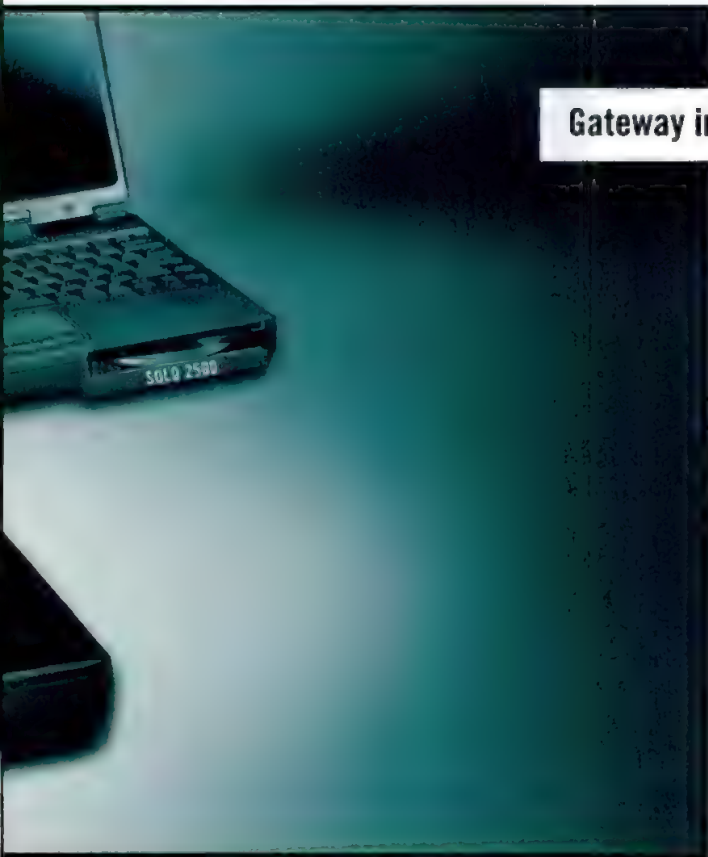
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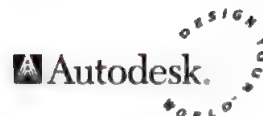
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DIGITAL VIDEO

Hollywood Goes to the Web

There's a renaissance underway for video on the Web, led by the affordability and ubiquity of digital video equipment and new standards. Digital movies reached a new milestone in May, when the first full-length digital movie was released simultaneously on the Internet and in theaters.

Key enabling technologies such as digital video recorders and digital projectors are now widely available, and new standards are being nailed down for turning legacy video formats into searchable, digitized streaming video content. Digital video recorders offer twice the resolution you typically get with a basic (VHS) camcorder. And the video images—and the copies—are cleaner.

Online film distribution company ifilm.net recently released a 97-minute independent film called *Dead Broke* on the Internet, viewable with Windows Media Player. In conjunction with the Internet release of the film, New York's Tribeca Film Center (owned by actor Robert DeNiro) downloaded a digitized version of the film from the Internet and showed it using a Hughes/JVC digital projector. "The distribution of films over the Internet for the-



WEB PREMIERE: Actor Paul Sorvino stars in the first full-length film released on the Web, titled *Dead Broke*.

aters can allow us to practically eliminate the cost of distribution," says Rodger Raderman, founder and CEO of ifilm.net, who foresees many full-length movies released on the Web.

One of the stickiest issues surrounding digital video on the Web is coming up with a way to copy-protect content to avoid piracy. A committee of multi-industry companies, called the Copy Protection Technical Working

Group, has been working on a way to create watermarks for digital video content. A standard from either IBM or Philips is expected to be finalized this summer.

Another widespread challenge as Web-based video goes digital is automating the transfer of nonstreaming video from old formats to streaming formats—called digital transcoding. Much of the video content available on the Web now is still in formats such as AVI. To that end, a company called encoding.com has produced an application titled mediaUpgrade.com that can take, say, a set of AVI files and automatically convert them to streaming video.

A San Mateo, California, start-up called Virage has developed a set of standards and technologies for making streaming digital video content—and associated text transcripts—searchable. The start-up foresees everything from university lectures to corporate training videos and news broadcasts becoming as easily available and searchable as text is on the Web now.—*Sebastian Rupley*

DIGITAL VIDEO

Star Wars Goes Digital

Star Wars Episode 1: *The Phantom Menace* is making history as one of the first major film to be shown with digital cinema equipment. The new technology uses direct-address projectors, which are similar to portable LCD projectors but built on a larger scale to create a larger, brighter image.

This approach eliminates the problems of creating and distributing heavy, expensive reels of film. Instead, movies can be downloaded via network or digital satellite connections and stored at the theaters until needed. If demand for a new movie exceeds expectations, it can be shown on additional screens without the need to obtain additional prints. And in side-by-side demonstrations with traditional film, many viewers find the digital projection images sharper and more stable.

The Phantom Menace will be

transmitted via satellite and shown digitally in two cities—unnamed at press time—starting on June 18. Theaters in each of the cities will have digital projection equipment; one will use an ILA (Image Light Amplifier) projector

from Hughes/JVC, and the other will use a projector based on Texas Instruments DLP (Digital Light Projector) micromirror technology.

Star Wars creator George Lucas is currently shooting the next *Star Wars* prequel completely with digital equipment. The new movie will have no photographic film at all.—*Alfred Poor*



READY FOR MY CLOSE-UP, MR. LUCAS: Jar Jar Binks, a computer-generated sidekick in *Star Wars* Episode 1: *The Phantom Menace*, will be shown on digital projectors in four theaters this summer.

The Web Workplace

By Ben Z. Gottesman

These days, it's all too commonplace to fly cross-country simply to make a short presentation. Worse, you might find yourself on a whirlwind world tour making the same presentation over and over again to different audiences. Wouldn't it be better if you could make your presentation to everyone at once from the comfort of your office? Here are several Web sites that let you make interactive multimedia presentations over the Web, as well as sites for storing and sharing documents with your colleagues.



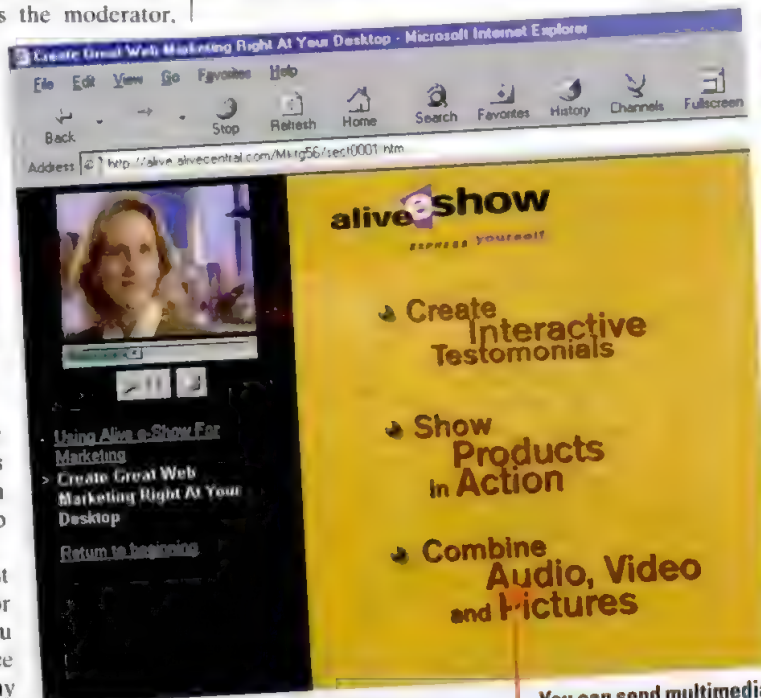
Make Presentations

► The Internet is the perfect medium for multimedia presentations, and several new services are beginning to pop up that make it possible. Astound has introduced **Astound Conference Center** (ae.astound.com), where you can present your Microsoft PowerPoint slides to anyone you want anywhere in the world via a browser. As the moderator, you perform a one-time download of Astound Publisher, which does a reasonably faithful conversion of your PowerPoint or Astound slides into HTML. You're then provided with a conference room number that you and your viewers enter at the virtual Conference Center site. Your audience can chat with you during your presentation, and you can easily tell whether everyone is on the same slide. You can also lead your audience to specific Web pages.

Astound lets you test out the service for free for one month. After that, you can create a conference room for your company starting at \$99 per month, or you can purchase Astound Conferencing & Learning Server to host conferences on your own servers.

Like Astound, ActiveTouch provides real-time, browser-based presentations and Web tours, but it adds document and application sharing, all for free. As part of the service, you can get a permanent Web page—called a **WebEx Office** (www.webex.com)—where you can maintain a calendar and address book and publicize upcoming pre-

sentations. Unlike Astound, ActiveTouch uses a proprietary meeting plug-in that visitors might find a bit inconvenient, and it doesn't provide the same wealth of feedback. ActiveTouch hopes you'll like the service enough to upgrade to one of its premium fee-based services such as branded WebEx sites.



You can send multimedia Web presentations to your customers and colleagues using e-Show and the AliveCentral hosting service.

When Microsoft Office 2000 hits the streets, you'll be able to launch Web presentations without even leaving PowerPoint. The new version of PowerPoint lets you create moderated and unmoderated presentations right from the Slide Show menu. But if you want to present to more than 16 people or across the Web, you'll need a NetShow server. Or you could access a third-party host, such as **Activate**

(www.activate.net), from the Online Broadcast dialog.

If you'd rather let your audience view your presentation at their leisure, consider Alive.com's **AliveCentral** (www.alive.com). In combination with the simple authoring tool Alive e-Show (\$195 list), you can easily create presentations with video and audio narration. The service starts at \$75 per month, or companies can purchase Alive e-Show Server for hosting presentations on their own intranets.

Store Documents

► Users are quickly waking up to the benefits of storing data on the Internet. **My Docs Online!** (www.mydocsonline.com) lets you store 20MB securely at its site for free. You can also use the service to share files. Rather than mailing around large attachments, you can simply send a link that lets recipients download files at their convenience. My Docs Online! helps you track who has actually retrieved your files as well.

Microsoft is doing its best to turn the Internet into a hard disk with its new Web Folders feature, introduced in Internet Explorer 5.0 and in the forthcoming Office 2000. The Web Folders feature lets you open and save files on the Internet as easily as on your hard disk. If you can't persuade your IT department to enable Web Folders on your intranet servers, that's no problem. **Filehome.com** (www.filehome.com) is offering secure Web Folders on its Web site. Filehome plans to offer a small amount of storage on its server for free so you can try out the service. Pricing starts at \$4.95 per month for 25MB of storage space and \$9.95 per month for 50MB.

If your electronic document has to get there immediately and securely, consider the United Parcel Service's **UPS Document Exchange** (www.exchange.ups.com). As with My Docs Online!, the service lets you

leave documents for others on a secure server, but UPS gives you a \$100,000 guarantee that your documents will get to the intended recipients—and only the intended recipients—without modification. **PC**

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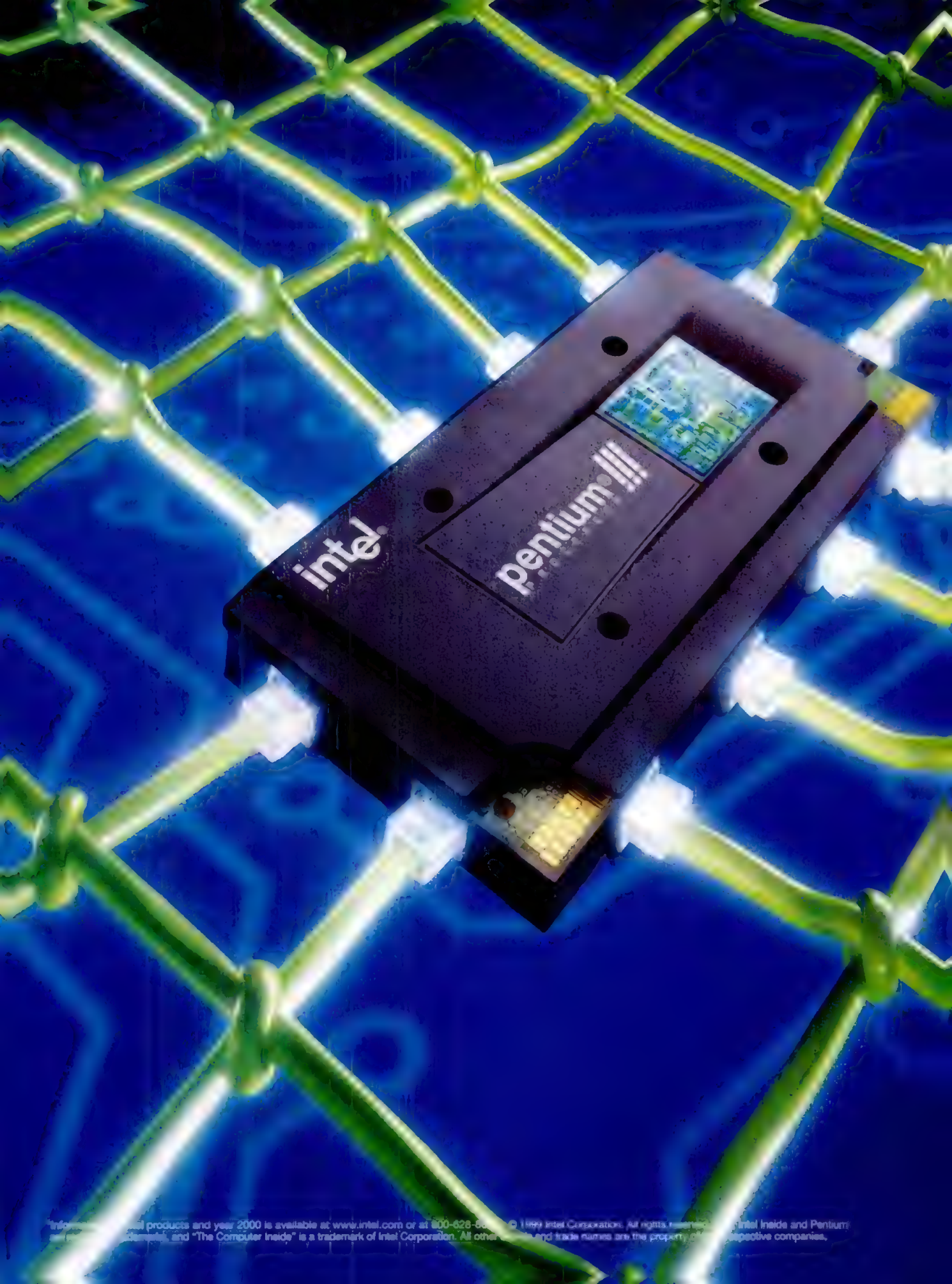


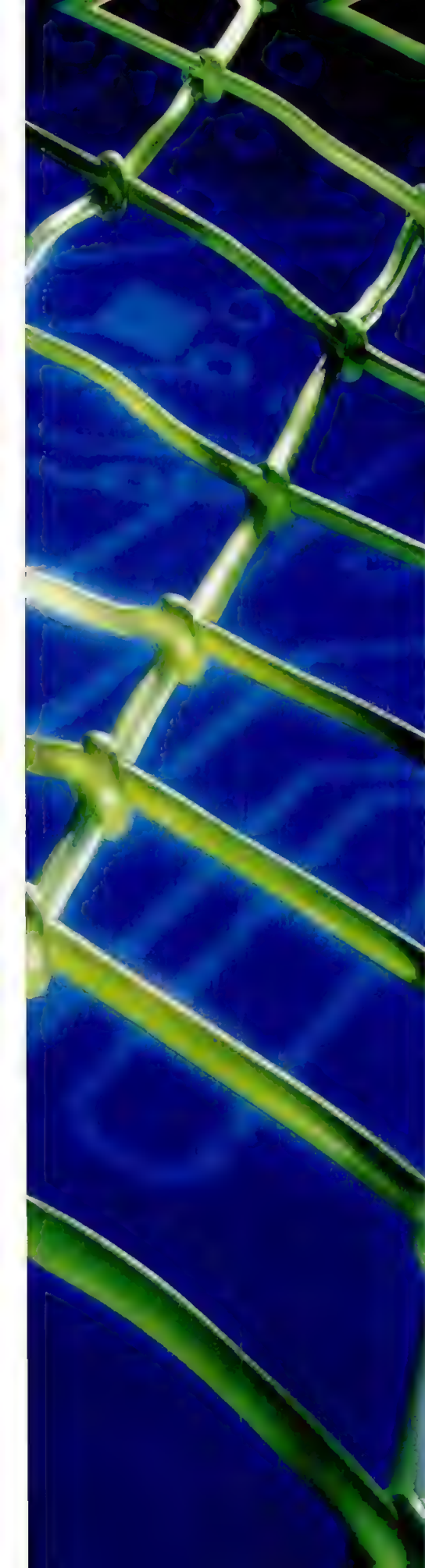
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Cheap 1-Megapixel Digital Cameras

Prices are dropping as usability increases, with 1-megapixel cameras from Eastman Kodak, Polaroid, Toshiba, and Yashica.

By Daniel Grotta and Sally Wiener Grotta

When they were introduced last year, 1-megapixel digital cameras were priced between \$750 and \$1,000. Most offered an assortment of advanced features such as manual and program modes, sound annotation, burst mode, video recording, and a rotating lens. But the biggest selling point was that they were the first generation of digital cameras to deliver true 35mm-like, photographic-quality prints.

The latest 1-megapixel digital cameras are a far cry from their predecessors in price and functionality. Priced between \$300 and \$500, they are bigger, boxier, and simpler to use, with fewer features. But the bottom line is great for consumers: The cameras still deliver

the same high-quality images.

We looked at four 1-megapixel digital cameras: the Eastman Kodak DC200 Plus (\$400 street), the Polaroid PhotoMax PDC700 (\$300 street), the Toshiba PDR-M1 (\$320 street), and the Yashica Samurai 1300DG (\$500 street). Three of the cameras are true megapixel devices, whereas the PhotoMax uses hardware interpolation to boost its CCD to megapixel status.

The cameras are all roughly the same size and weight. The Samurai resembles a tiny camcorder, and the PhotoMax looks like a portable FM radio; the Kodak and Toshiba units each have a more traditional camera look. All accommodate either CompactFlash or SmartMedia memory cards, though the PhotoMax ships with 4MB of built-in memory with an optional CF card.

Each camera has both an opti-

cal and LCD viewfinder, a video-out port, and a built-in strobe. In addition, each except the Toshiba unit has a LCD control panel for status updates. And other than the PhotoMax, with its fixed resolution of 1,024 by 768, the cameras offer at least two different resolution modes for faster viewing of posted images on the Web.

There are other commonalities: Each camera comes with a Twain driver; only the PhotoMax does not come with a Mac driver or cable. Each connects to a PC via a serial cable (and not via USB). All save image files in JPEG format; the Kodak unit gives you the option to save in either JPEG or FlashPix. Each camera is powered by four double-A batteries, but only the Polaroid camera bundles an AC adapter.

Unlike earlier cameras with lesser resolutions that have quickly succumbed to improved

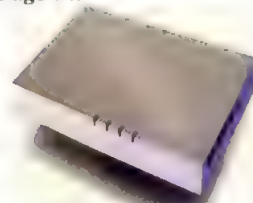
LUCKY SEVEN:

The wireless Palm VII adds e-mail, e-commerce, and Web clipping to the Palms' list of abilities. *Page 53.*



UNLEASH YOUR LAN:

The Lucent WaveLAN EC lets you expand your wireless network to include any device with an Ethernet connection. *Page 74.*



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technology, it's unlikely that 1-megapixel cameras will be rendered obsolete for some time. They have just enough resolution to output great-looking 8.5-by-11 glossy prints and more than enough resolution for posting pictures on the Web.

For many applications, multi-megapixel, state-of-the-art digital cameras with their high resolutions and numerous features represent expensive overkill. Most 1-megapixel digital cameras will likely remain relatively simple in design and operation—and attractively priced—even with the advent of the 2- and 4-megapixel devices slated for rollout over the next year.

Eastman Kodak DC200 Plus

Currently Kodak's lowest-priced 1-megapixel digital camera (\$400 street), the DC200 is a large, traditional-looking black camera, with a rounded top, rubberized front grip, and finger indent in the rear. The optical viewfinder is set almost in the middle of the back, making it difficult for lefties to use.

The DC200 is the only camera in our roundup with a fixed-focus, fixed-focal-length lens. This means that you don't have



Eastman Kodak DC200 Plus

Street price: \$400
Eastman Kodak Co.,
Rochester, NY;
800-235-6325
www.kodak.com

to worry about precise focusing: Everything from 27 inches to infinity will be sharp. It also means that the DC200 does not have macro-mode capability. But Kodak incorporated a 37-mm thread-in lens mount that lets you screw in optional auxiliary *proxar* (close-up), wide-angle, and telephoto lenses.

Setup of the DC200 is quite easy. The modes and preferences are listed in clear language (actually, a choice of six languages) and are visually reinforced with easy-to-understand graphics: For instance, in selecting com-

pression level, the choices are Good, Better, and Best. The About option informs you of the firmware version and gives a variety of status reports, including the number of images captured and the number of flashes fired.

Although you can save images in standard JPEG or FlashPix format, the otherwise excellent documentation doesn't explain when to use which. And unlike more expensive Kodak digital cameras, the DC200 does not incorporate the FlashPoint operating system. It does include templates, though, for icons and borders that can be permanently attached to any picture. A Family template with a fun border is built into the firmware, and additional templates can be acquired from Kodak's Web site and loaded on the camera's CF card. PictureEasy 3.1 is included with the camera.

You take pictures by simply turning the camera on, pointing it at your subject, and pressing the shutter. The camera takes almost 8 seconds to power on. Depending on your preferences (LCD on, template on, and so forth), recycling averages just under 12 seconds but can be as long as 21 seconds.

Navigating the DC200 is easy, once you learn the difference

between the bottom buttons and back arrows. The mode dial on the back is large and well marked and lets you quickly switch among Picture, Setup (preferences), Playback, and PC Connect modes. The LCD is unusually bright, sharp and colorful, even in sunlight. Paging through images is easy, because the camera instantly displays tiny thumbnails—its Memory Bar—along the bottom; this is far faster than waiting for a full LCD image to build.

In Best mode, the DC200's uncompressed image is 2.9MB in size, and the original FlashPix file is 462K. Our test image had a pleasing appearance, but it could have been better: The lighting was about one stop underexposed, giving greater, slightly unrealistic saturation to the otherwise accurate colors. Details were good but not excellent, and there was some visible pixelation.

Simplicity, ease of use, a great LCD, helpful documentation, and an ability to capture very good images all make the Eastman Kodak DC200 Plus a fine choice for the point-and-shoot crowd.

Polaroid PhotoMax PDC700

At \$300 street (including an AC adapter), the PhotoMax PDC700 is the least expensive camera we tested; unfortunately, it resembles a knockoff of Fuji's stylish and successful MX-700 and MX-2700 digital cameras. The PhotoMax has a light- and dark-gray plastic body that's taller than it is long, making it just too wide to stuff into a shirt pocket. The buttons are small and identified by icons and abbreviations rather than clearly labeled English. And the manual focus level on top has only two positions: macro (with an 8-inch closest focus) and everything else.

Despite its appearance and the fact that the PhotoMax has the least dense CCD in our roundup, its test image ranked

SUMMARY OF FEATURES

Cheap 1-Megapixel Digital Cameras

	Eastman Kodak DC200 Plus	Polaroid PhotoMax PDC700	Toshiba PDR-M1	Yashica Samurai 1300DG
Street price	\$400	\$300	\$320	\$500
Weight	13.6 ounces	12.3 ounces	11.4 ounces	14.8 ounces
Dimensions (HWD, in inches)	3.2 x 5.1 x 1.9	5.4 x 2.6 x 1.9	3.3 x 4.9 x 1.4	3.6 x 2.3 x 4.8
Number of CCD pixels	1.01 million	805,486*	1.50 million	1.32 million
Resolutions	1,152 x 864, 640 x 480	1,024 x 768	1,280 x 1,024, 640 x 480	1,280 x 960, 640 x 480, 320 x 240
Lens	Fixed	Manual	Auto-focus	3X auto-focus zoom
Shutter speed range (seconds)	1/2–1/362	1/10–1/10,000	1/4–1/1,000	1/8–1/1,000
Memory and type	4MB CompactFlash	4MB internal (accepts CompactFlash)	4MB SmartMedia	8MB CompactFlash
ISO equivalency	140	200	100	100
Maximum number of storable images	High 36; standard 24; economy 36	High 12; normal 25; economy 50; high VGA, 24; normal VGA, 50; economy VGA, 100	High 5; normal 11; economy 22; high VGA, 24; normal VGA, 45; basic VGA, 80	High 10; standard 40; normal 160; economy 390

* The Polaroid camera uses hardware interpolation to boost its CCD to megapixel status.

just below that of the Toshiba camera in image quality. Our test shot was overexposed by one-half of an f-stop, but the camera accurately captured midtones and shadows. Detail was excellent, and colors were very good.



Polaroid PhotoMax PDC700

Street price: \$300

Polaroid Corp., Cambridge, MA;

800-343-5000

www.polaroid.com

Setting up may take some trial and error until you figure out which buttons to push. The icons and settings are mostly self-explanatory. One quirk we discovered was in programming the time, date, and auto-turnoff; numbers for each range from 0 to 9, making it possible to set 99:99 A.M., for example.

Also, although the LCD viewfinder has a very fast refresh rate, it's virtually impossible to see in bright light, even by turning the manual brightness wheel on the bottom of the camera. The unit ships with 4MB of built-in memory; you can easily copy images between the built-in memory and an optional CF card.

Taking pictures is point-and-shoot simplicity. The camera is comfortable to hold and can easily be operated with one hand. You have the option to see the just-shot image on the LCD viewfinder instantly and delete it before saving.

Unfortunately, though, the macro switch doesn't display anything in the control panel,

LCD, or viewfinder to indicate how focus is set, so you could shoot an entire out-of-focus session and not know it. The PhotoMax's white balance is fully automatic, but you can manually adjust it for bright sun, shade, incandescent, and fluorescent, though not for mixed lighting.

The camera needs about 7.5 seconds before it's ready to take the first shot and about 6.5 seconds to recycle. Downloading to the computer can be slow; the highest speed we were able to achieve was 38 Kbps. The simple and attractive interface can be used as part of Polaroid's excellent PhotoMax 2.4 image-editing program (included) or as a Twain driver.

The Polaroid PhotoMax PDC700 will appeal to budget-minded families who don't want to fight technology to get good pictures.

Toshiba PDR-M1



At first glance, the Toshiba PDR-M1 (\$320 street) could be mistaken for a fine German camera. Its silver metal skin, gray rubberized grip, and circular lens cap are distinctive and attractive. The body is further enhanced by front and back pimples, for surer gripping.

Oddly, the circular lens cap does not double as an on/off switch. The switch is just to the right of the shutter button, and it requires some pressure to activate. Although a novice will probably have little difficulty figuring out how to operate this camera, Toshiba's documentation is well written, comprehensive, and adeptly organized and illustrated.

On the rear of the camera is a large mode dial with universal, well-marked, easy-to-understand icons. The camera has no control panel, so all settings and changes are done through the LCD menu. Navigating the menu is a breeze, due in no small part to the

Editors' Choice

• Toshiba PDR-M1



Though we feel confident recommending any of these 1-megapixel digital cameras, the Toshiba PDR-M1 is our Editors' Choice by a wide margin. Ergonomically, its traditional camera design will give you a solid, reassuring feeling of quality and confidence: Although the unit is no speed demon, it's fun to shoot because it's easy to hold and handle and because the buttons and dials are logically positioned and labeled. Navigating through the menus is a simple task even for novices, since all the modes and parameters are displayed in clear, unambiguous English.

Although the PDR-M1 misses being our lowest-priced camera by only a few dollars, it rivals digital cameras costing hundreds more. Its 1.5-million-pixel CCD offers the highest resolution and largest image-file size. That, along with a true auto-focus lens—which can capture close-ups down to 3.5 inches—helped produce the best pictures of the cameras we tested. We especially liked the unit's playback zoom, for viewing images in greater detail. And although we may never use them, we appreciate advanced features such as synchro mode, three degrees of sharpness, 2X digital zoom, and variable flash output.

well-lighted English commands and the easily manipulated four-position button above the LCD. All ports are instantly accessible, and for safety, when the Smart-Media card compartment is opened, the camera turns off. The auto-focus lens is a fixed focal length, but you have the option of

toggling to the camera's 2X digital zoom. You can focus as close as 3.5 inches in macro mode.

Although it has no manual override, the Toshiba camera offers considerable latitude to those who want to go beyond default-mode photography. You'll find a command for changing the intensity of the flash, so you can adjust for difficult lighting conditions. Moreover, the camera has five levels of flash, and the intensity can be altered for close-ups and for when the subject is very small.

You can set the camera's white balance automatically or select among five lighting conditions. For night and backlit shots, the PDR-M1 has a pro feature, *synchro mode*, that synchronizes a slower shutter speed with "rear curtain" flash for better illumination. The LCD is slightly jerky and grainy but not distracting.

Shooting performance is average for digital cameras. The camera takes just under 6 sec-



Toshiba PDR-M1

Street price: \$320

Toshiba Imaging Systems,

Division, Irvine, CA;

800-288-1354

www.dsc.toshiba.com

FIRST LOOKS

onds to turn on. The recycle time is about 8.5 seconds when the shutter is half-depressed (which sets the focus and exposure) and 11.5 seconds when you don't depress the shutter.

Where this camera shines is in playback mode. With the push of a button, you can enlarge an image up to 400 percent, in 100 percent increments. With video-out and the ability to upload images to the CF card, the camera can be programmed to present slide shows.

Not surprisingly, image quality was a cut above that of the other cameras. Our test shot was accurately exposed and had both sharp detail and excellent color. Its 1.5-megapixel CCD—the densest in our roundup—produced the largest raw JPEG file (660K) and the largest uncompressed file (3.8MB). Image Expert from Sierra Imaging is bundled with the camera.

Considering its low price, high image quality, and useful though limited feature set, the Toshiba PDR-M1 is an outstanding value for amateurs and businesses alike.

Yashica Samurai 1300DG

The most expensive camera in our roundup, with an impressive list of features, the Yashica

Samurai 1300DG (\$500 street) should have ranked at or near the top. It's the only camera we tested with a 3X auto-focus power-zoom lens, the ability to capture images in sepia or black and white, and a continuous mode that lets you shoot at speeds of up to one frame every 4 seconds. But the Samurai was inconvenient and even uncomfortable to use, and its image was the lowest quality of the tested group.

The gray and black Samurai is an unconventionally shaped camera, long rather than flat. A hand strap and thumb indentation make it somewhat awkward to hold up to the eye: You must jut your elbows out and keep the camera rigidly level, which quickly becomes tiring.

Setup isn't difficult, but it's not obvious either. Toggling and depressing the zoom rocker switch to move among the functions is tricky at first. The mode labels displayed in the LCD are not always clear (OSD and Wide Angle Adj. for example), though the control panel icons are unambiguous.

Selecting preferences and parameters can be tedious. You have to press the zoom button as many as six times to get to the desired mode, and then up to five times on the zoom rock-



Yashica Samurai 1300DG

Street price: \$500

Kyocera Optics Inc.,

Somerset, NJ;

800-526-0266

www.yashica.com

er switch to set the mode. Documentation is of little help: The booklet is printed in four languages, and the text is badly translated and poorly organized.

To shoot, you just turn the camera on, flick the zoom rocker switch, and press the shutter. The Samurai took almost 5 seconds to power on, but recycling takes anywhere from 9 to 13 seconds, depending on whether you're shooting in light or near darkness and whether you press the shutter halfway or click it all the way down. Up to 3 seconds can elapse between the time you

fully depress the shutter and when the image is recorded—plenty time for kids or animals to fidget.

Continuous shooting works so long as you continue to depress the shutter. In Continuous mode, the flash is not available and the focus and zoom cannot be changed from the first frame (these do operate in fine mode, however). We were unable to achieve a timing of less than 7 seconds per shot, considerably less than the rated 4 seconds per shot. The documentation notes that times will vary according to conditions.

Our test image's quality was slightly soft, and it was nearly 2 stops underexposed, with very little data in the midtones. Exposure aside, the colors are excellent and pleasing, especially in mixed lighting. Even though the test image didn't fare well, we had no exposure problems shooting indoors with both incidental and strobe light. For bundled software, PhotoDeluxe 3.0 is included.

The Yashica Samurai 1300DG's unusual size and zoom lens, coupled with its extra features, may be useful to those who need more versatility than some low-priced 1-megapixel digital cameras deliver. **PC**



Eastman Kodak DC200 Plus



Polaroid PhotoMax PDC700



Toshiba PDR-M1



Yashica Samurai 1300DG

These images were shot at each camera's closest available focal length (the Samurai's shot was taken with its telephoto lens); the resolutions are at the highest settings and best quality. The DC200's image is about one stop underexposed, so colors are somewhat oversaturated. The PhotoMax captures midtones and shadows, showing excellent detail and color. The PDR-M1 produced an accurately exposed shot with sharp detail and great color. The Samurai's image is slightly soft and nearly two stops underexposed, with little midtone data but exceptional color.



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Apple-Style Streaming

The beta release of QuickTime 4 bodes well for Apple's future in streaming media.

By Jan Ozer

Apple's beta release of QuickTime 4 addresses key limitations that dissuaded many corporations from using the technology for streaming audio or video. Although QuickTime still trails products from both Microsoft and Real Networks in video quality, audio quality is competitive, and both server and basic player are free. QuickTime 4 is worth a look for all sites considering streaming media, especially those leveraging other QuickTime formats such as QuickTime VR.

Despite QuickTime 3's ability to synchronize video, audio, still-image, text, and animation formats, it ranked a distant third behind Microsoft's Windows Media Technologies (WMT) and Real's products for true streaming media. QuickTime's major flaw was the lack of a server component with such features as network bandwidth protection and multicast transmissions. And QuickTime's audio/video codecs simply didn't match up at data rates of 28.8 and 56 Kbps. These were the issues Apple sought to address with QuickTime 4.

include the ability to limit QuickTime traffic on an intranet (a required enterprise feature), and live and on-demand streaming, but not multicast.

Significantly, however, Apple made the Streaming Server open-source and freely downloadable from its Web site, letting other developers add features and port the server to Linux, Unix, Windows NT, and other platforms. But since the server doesn't currently run under Unix or Windows NT, we were unable to test it for this review.

FORMAT QUALITY

Another priority for Apple with QuickTime 4 was improving audio/video quality, specifically the QDesign and Sorenson codecs that spearhead QuickTime's Internet offerings. For our tests, we used beta copies of the professional versions of the QDesign Music Codec (\$399 direct) and Sorenson Video Developer, Edition 2.0 (\$499), encoding with a beta copy of Terran Interactive's Media Cleaner Pro 4.0 for Windows (\$499 direct). Though a bit elaborate, this matches the setup likely to be

Microsoft and Real in quality. At 28.8 Kbps, low-motion clips showed slightly less detail, and high-motion sequences slowed to as few as one frame every 3 or 4 seconds. At higher data rates, we saw blocks and other arti-

which now features volume control, a tiny volume indicator, and the ability to save favorites in a "drawer." Strangely, when you play a video, two windows open: the interface window with playback controls and another player, which looks like the QuickTime 3 player, with controls for saving favorites and video scaling. Locating all relevant controls took some exploring.

Upgrading to QuickTime Pro (\$29.95) gives you bass, treble, and balance controls but not the color and brightness adjustments available in both the Microsoft and Real players. We liked the ability to step through the videos frame by frame, but we missed right-mouse menus, which might have smoothed out the rough edges of the new dual-window approach. Although it's a grand improvement over previous versions, the



PLAY ON: QuickTime 4's new player requires the QuickTime 3 player to set favorites and zooming.

facts in the Sorenson videos not evident in the Microsoft or Real videos, probably the result of the post-compression filtering both technologies perform.

On the audio front, the QDesign codec yielded generally strong but mixed results. On 28.8-Kbps tests, QDesign produced excellent quality on our symphony and string-quartet clips, but the rock clip sounded muffled, and we noticed slight distortion with a female soloist's voice.

On tests of 56 Kbps and higher, the results are much closer, and only audiophiles performing direct comparisons will notice a difference. With the QDesign codec, QuickTime is certainly competitive with Microsoft and Real.

FLASHY NEW PLAYER

Apple added a glossy new interface to its standalone player,

new player is less functional than both Real's and Microsoft's, and it's certainly miles behind Real's new RealJukebox (reviewed in First Looks, page 51), which provides more playback features plus integrated CD-ROM ripping and encoding to MP3 and RealAudio formats.

Although a strict feature-by-feature comparison with either Real's or Microsoft's products will find QuickTime 4 lacking in most categories, the new release is close enough to be worth considering by developers who want QuickTime's other strengths. This release also signals Apple's intention to devote serious attention to the streaming media marketplace.

QuickTime 4. Free download. Requires: 16MB RAM, Windows 95, 98, or NT. Apple Computer Corp., Cupertino, CA; 800-795-1000; www.quicktime.com.



BLOCKY: In this high-motion shot at 100 Kbps, note the distinct blocks in the QuickTime footage not present in the Microsoft or Real shots.

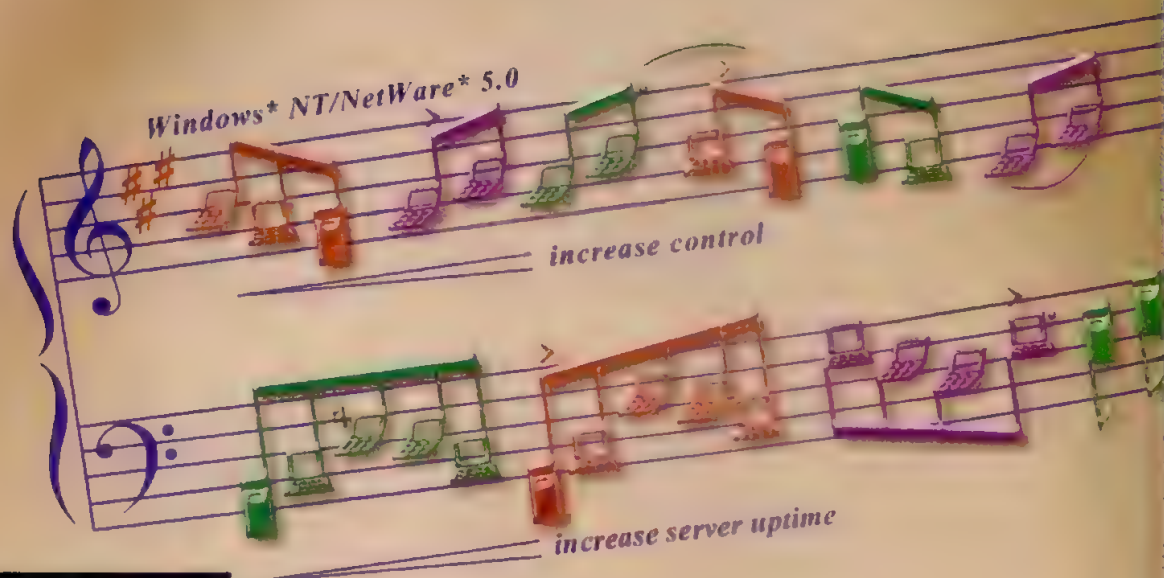
ROLL YOUR OWN SERVER

As the server portion of QuickTime 4, Apple released the QuickTime Streaming Server for the Mac OS X. Key features

used by most Web developers employing QuickTime.

We found that on video tests, the Sorenson codec was vastly improved but still trailed both

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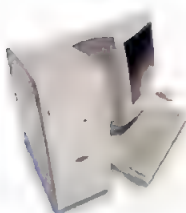
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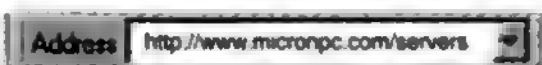
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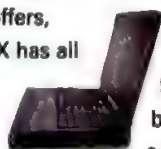
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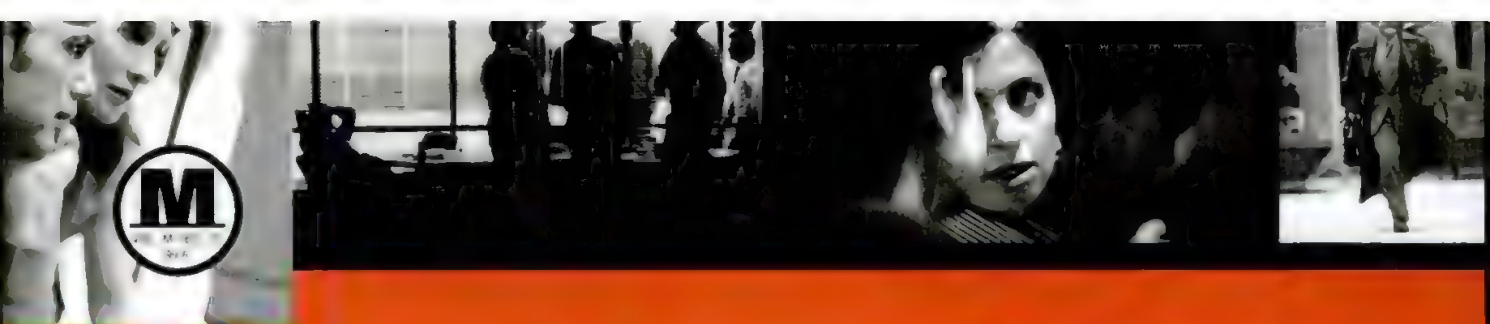


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Monitor Not Included



Monitor Not Included

Model Name	Millennia® C400	Millennia C466	Millennia C466
Processor	Intel Celeron processor 400MHz	Intel Celeron processor 466MHz	Intel Celeron processor 466MHz
RAM	64MB SDRAM	64MB SDRAM	128MB SDRAM
Hard Drive	8.4GB Ultra ATA hard drive*	8.4GB Ultra ATA hard drive*	13GB Ultra ATA hard drive*
DVD/CD-ROM	6X variable speed DVD-ROM drive	6X variable speed DVD-ROM drive	40X variable speed CD-ROM drive*
Modem	3Com USRobotics V.90 WinModem**	3Com USRobotics V.90 WinModem**	3Com USRobotics V.90 WinModem**
Graphics	8MB nVidia Riva 128ZX AGP 2X graphics	8MB nVidia Riva 128ZX AGP 2X graphics	8MB nVidia Riva 128ZX AGP 2X graphics
Micron U	1-year free ¹ training @ Micron U online	1-year free ¹ training @ Micron U online	1-year free ¹ training @ Micron U online
Onsite Warranty	3-year on-site limited warranty	3-year on-site limited warranty	3-year on-site limited warranty
Operating System	Microsoft Windows 98	Microsoft Windows 98	Microsoft Windows 98
MConnect	Micron pays for 1 year EarthLink Sprint TotalAccess™	Micron pays for 1 year EarthLink Sprint TotalAccess™	Micron pays for 1 year EarthLink Sprint TotalAccess™
Factory Direct Price	\$34/mo. \$1,099 Business Lease 48 mos.**	\$35/mo. \$1,149 Business Lease 48 mos.**	\$40/mo. \$1,299 Business Lease 48 mos.**

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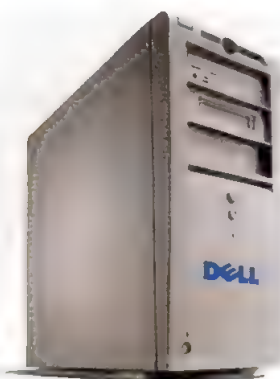


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The Real Music Thing

RealJukebox signals a sudden and spectacular end to the adolescence of PC-based music.

By Don Willmott

The way you listen to music on your PC is going to change forever. The exquisitely designed RealJukebox (a free download) from RealNetworks is the be-all, end-all utility that you'll use to play and manage all the music you bring into your PC, whether you

download MP3 files, pull tracks off your CDs, or buy copyright-protected download-able songs from established artists sometime in the future. It has the right mix of features and functions to render most of the CD players, MP3 encoders, and MP3 players you've used before instantly obsolete. Anyone who has a re-

cent version of RealPlayer G2 can get RealJukebox simply by using G2's AutoUpdate feature. It all starts with what appears at first glance to be a straightforward CD player. Pop an audio CD into your CD-ROM drive and let the music play. If you're online, RealJukebox goes out to CDDb (www.cddb.com) and pulls track, artist, album, and genre information into the player. All the expected features—volume, shuffle play, and the like—are right where you expect them to be.

But something else is going on. As your CD plays, RealJukebox is simultaneously doing the job of a CD "ripper," automatically encoding the songs into MP3 or RealAudio format. There are three levels of recording quality: 56 Kbps, 64 Kbps, and 96 Kbps. (Hard-core music lovers would like to see an option for 128-Kbps recording.) The higher the quality of music you want stored, the bigger the resulting file.

We found that an entire CD recorded at 96 Kbps takes up between 40MB and 50MB of disk space; the program will even calculate how many CDs you can record before your hard disk is full. (You can, of course, choose to play and record only selected tracks. By default, song files will play only on the system



MULTITASK: RealJukebox player simultaneously monitors both the track you're playing and the track you're recording. Track information is pulled from CDDb.

on which they were recorded, meaning that you can't e-mail that hot new single to a friend.)

What's especially remarkable is that depending on your processor power, the encoding can be stunningly fast. Even on slow systems, 96-Kbps recording usually keeps up with the songs as they play. On faster systems or at lower levels of audio quality, RealJukebox can record four or five times as fast as the songs play, actually outpacing you as you listen to your CD. RealJukebox also lets you record silently in the background.

EASY MANAGEMENT

Once you've encoded all your favorite songs, you'll need to manage them. One click to the Music Library reveals an excellent music database that lets you sort your songs alphabetically by artist, by album, or by genre. All the notations are editable, so you can classify your tunes any way you like. You can also cre-

ate playlists for any occasion simply by dragging and dropping songs. The program also imports CD-Streamer, M3U, and PLS playlists.

And all the same functionality applies to the collection of songs you've already downloaded to your hard disk from other sources. In addition to MP3 and RAM, RealJukebox handles RA, RM, RMI, RMP, and WAV files. Just import them (or drag them) into the Music Library and they'll instantly put themselves in the correct folders as best they can.

As a true unified music player, RealJukebox is designed not only to turn your PC into a music box but also to export playlists to portable devices like the Diamond Rio PMP300 Portable Music Player or the upcoming Nomad from Creative Labs. You can easily imagine adding a few gigabytes of portable mass storage to your home stereo system in the not-too-distant future.



TRACK YOUR TRACKS: The Music Library gives you countless options for managing your music. Build custom playlists simply by dragging and dropping songs.

WEB MUSIC

The third major component of RealJukebox is a window to the world of downloadable online music. Links that RealNetworks plans to update frequently take you straight to some of the best sites for free downloads and promotional songs as well as to music search engines.

Recording industry executives should be glad to hear that RealNetworks has designed the software to work with upcoming secure music standards such as SDMI as well, so that in the future you should be able to



LOW IMPACT: With RealJukebox, enjoy your music without eating up lots of screen space.

purchase that hot new Sheryl Crow single and download it straight into RealJukebox, where it will play just like any noncopyrighted MP3 file. (You can also secure your own song files as you encode them.)

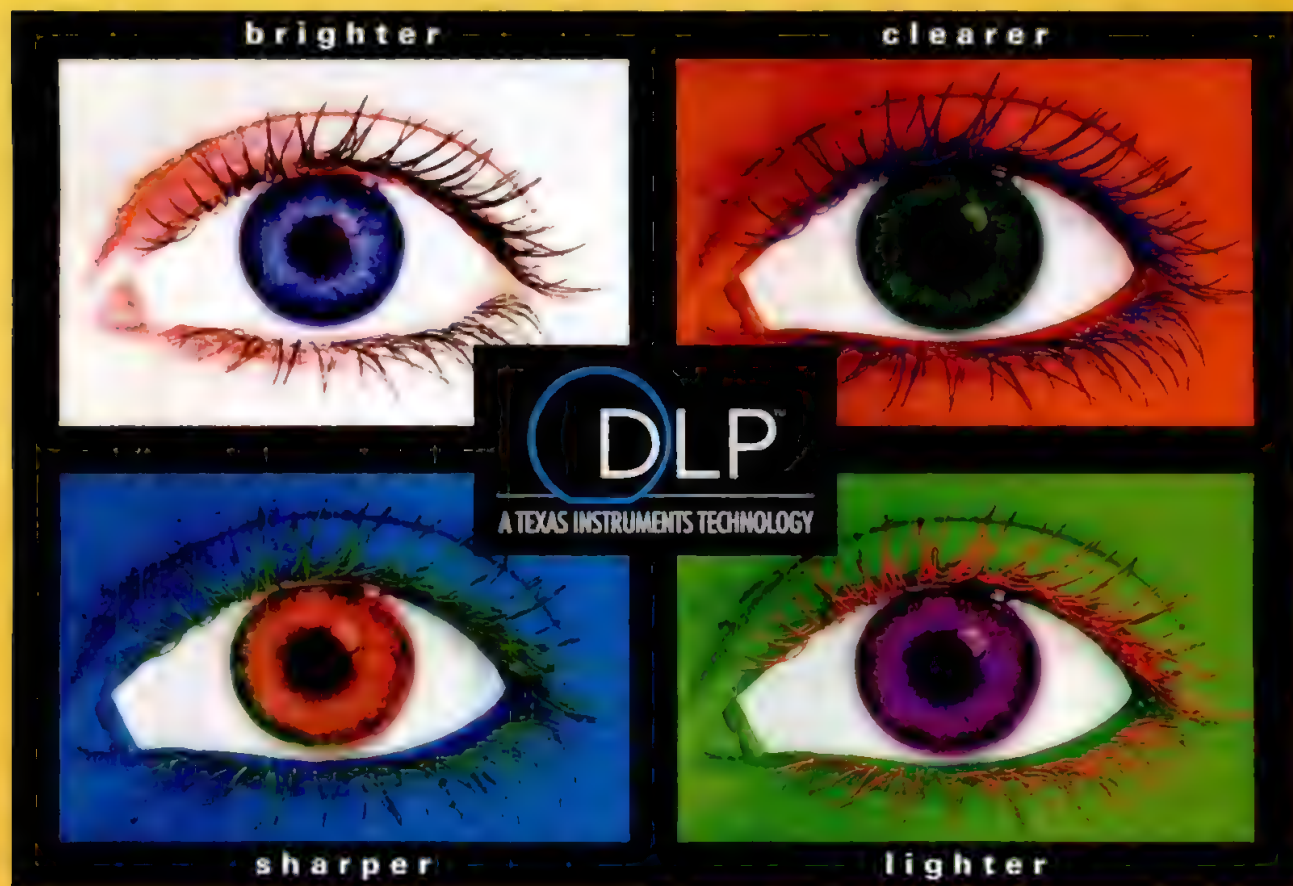
In conjunction with the arrival of RealJukebox, RealNetworks is pushing its complex set of back-end tools, collectively called RealSystem MP. They're designed to set standards for everything from music databases and portable devices to secure e-commerce services. Given RealNetworks' huge installed base of 60 million registered RealPlayer users, the company is in a good position to take a leadership role.

True online audiophiles will quibble with the lack of some esoteric audio features in RealJukebox, and they'll no doubt go on using the utilities they've come to enjoy. Chances are, however,

you'll be more than satisfied with all that RealJukebox can do for you and your music collection. In fact, you should be absolutely delighted.

RealJukebox. Price: Free. Requires: 16MB RAM, Microsoft Windows 95 or 98. RealNetworks, Seattle, WA; 800-444-8011; www.real.com.

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CREATING DYNAMIC VISUAL EXPERIENCES THROUGH DIGITAL SOLUTIONS

 **TEXAS
INSTRUMENTS**

The Wireless Palm VII

The new 3Com Palm VII adds wireless Internet information access to this most popular PDA.

By Bruce Brown

It's cool, it works, and it's for sale—but only in New York. Announced last December, the long-awaited Palm VII (\$600 street), from 3Com's Palm Computing subsidiary, is now available in the tristate metropolitan New York area (including Connecticut and New Jersey), with full national rollout expected later this year.

Now, in addition to organizing your contacts, tasks, and appointments on a pocket-size PDA, you can use the same device to send and retrieve e-mail and to query Web sites for information. You can't use the Palm VII to cruise Web sites, download files from FTP sites, or converse in chat rooms. You can exchange e-mail, do e-commerce transactions, and interact with specific Internet sites to retrieve information such as news, traffic, and weather reports.

READY, SET, WIRELESS!

The Palm VII looks like the Palm III, but it's about half an inch longer on top to accommodate a two-way wireless radio. Before you can start to communicate wirelessly, you have to charge the radio transmitter for 70 minutes—the only time you'll have to do so. Then, you extend the Palm VII's 4-inch rigid plastic antenna (which doubles as a power-on switch), enter your credit card information for wireless service billing, and presto! Your wireless communications begin.

Palm uses the BellSouth wireless data network, which covers more than 260 metropolitan areas in the U.S.; devices sold in the New York area will work in all BellSouth coverage areas. In testing in New York City and in Hartford, Connecticut, we used the Palm VII reli-

ably but found that even in areas rated Excellent by BellSouth's coverage map, signal strength varied significantly, depending on location.

The BellSouth network uses the 900-MHz Mobitex protocol, with a base connection speed of 8,000 bps. All Palm VII transmissions travel via the network through the Palm .net system for routing to and from parties. To ensure secure communications, both the SSL protocol and Certicom's Elliptic Curve Cryptography are used.

The Palm VII's two-way radio and antenna deliver wireless communication—e-mail and Web information retrieval—provided through the BellSouth data network.

Wireless e-mail isn't pushed to the Palm VII as it is with a pager; instead, you have to retrieve your mail. Received messages are stripped of attachments because of bandwidth limitations; you can choose to receive from 250 to 8,000 characters of any e-mail message. You can send e-mail to any e-mail address, but incoming mail is sent to your account at Palm.net.

There are two monthly service plans available for the Palm VII: Basic service (\$9.99 per month) includes 50K of transmissions, calculated as approximately 150 200-character Palm VII screens. Expanded service (\$24.99 a month) includes 150K of transmissions, or about 450 screens. The overage charge for each plan is 30 cents per kilobyte, or approximately a dime per screen. Currently, there is no unlimited-access plan.

CLIP THE WEB

The Palm VII's method of accessing Internet information is called *Web clipping*. Rather than browsing, you send information requests to content provider sites via the Palm network. The provider's graphics, menu, and query

forms are already stored on the Palm VII, so you don't have to download them each time you send a request.

After you make a selection—such as choosing NBA News in the ESPN.com application—the Palm VII accesses the wireless network to transmit your query. When the response returns (usually within seconds when signal strength is high), the data appears on the screen using graphics or forms that are already resident on the device. Because the system transmits such small amounts of data, the transaction can be speedy and relatively inexpensive.

LOTS OF CONTENT

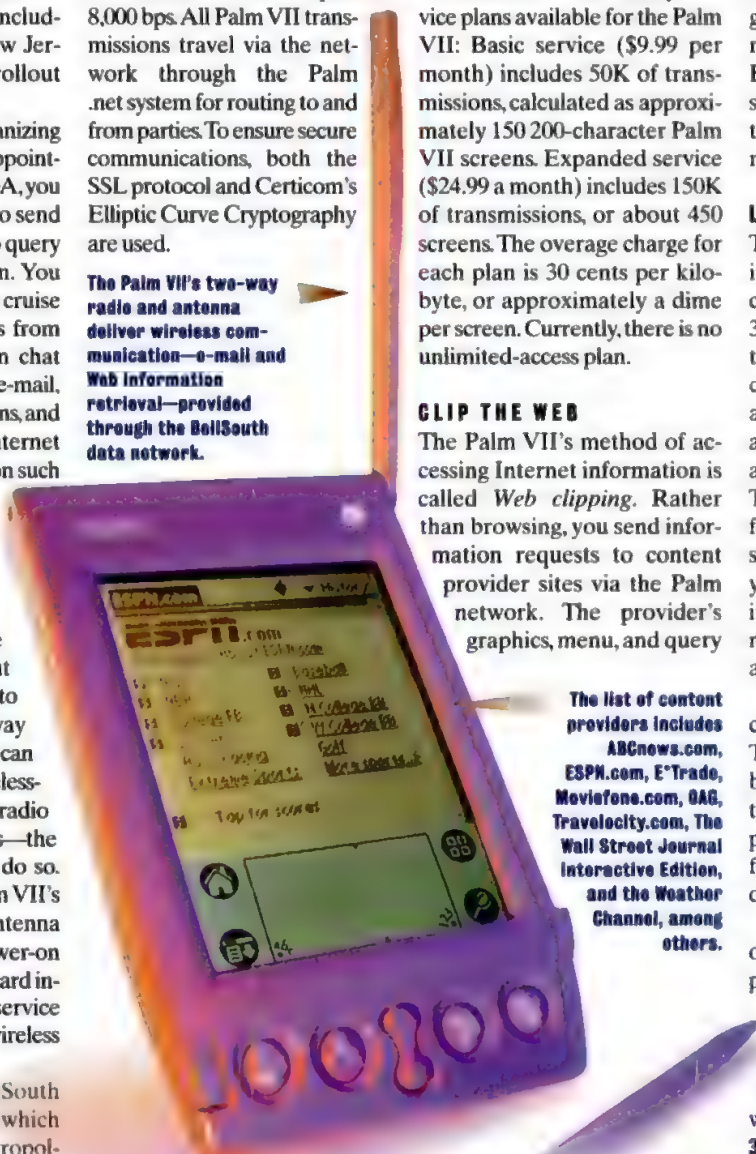
The value of the Palm VII lies in the number and quality of content providers who use 3Com's formats for responding to queries. Applications for querying 22 content providers are preinstalled on the Palm VII and provided on a CD-ROM and on the Palm VII Web site. These applications are transferred to the Palm VII when you synchronize the device with your PC. Query applications fall into four categories: financial, news, reference and directories, and travel and entertainment.

Communicating wirelessly can take a toll on battery life. The Palm VII's two double-A batteries are rated to last one to two weeks, depending on usage; previous Palm models have run for about a month on a set of double-As.

But the Palm VII's design and out-of-the-box usability are appealing. An ideal product would give you full Internet access, but there's no such thing—yet. Right now, the 3Com Palm VII sounds like a winner to us.

3Com Palm VII. Street price: \$600. Requires: 8MB RAM, 20MB hard disk space, Windows 95, 98, or NT 4.0. Palm Computing Inc., a 3Com company, Santa Clara, CA; 800-881-7256; www.palm.com.

JUST A LITTLE BIT LONGER: The Palm VII is about half an inch longer on top than previous Palms to accommodate its built-in radio.



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Lightweight LCD Projectors

New, less expensive ultralight projectors can produce brighter images that are easier on the eyes.

By Alfred Poor

The LCD projector market is growing rapidly, as brightness levels increase and prices fall—and the fastest growing segment is for projectors under 10 pounds. According to Stanford Resources, North American sales grew by a third last year for projectors in general, but tripled for the ultralight segment.

When we last looked at ultralight projectors ("Lightweight Projection," First Looks, November 17, 1998), three of the four projectors had SVGA (800-by-600) resolution and only one had XGA (1,024-by-768) resolution. The trend is toward higher resolutions, as demonstrated by the three XGA projectors and one lone SVGA projector in our current group. Two units rely on polysilicon LCD panels and the other two on Texas Instruments' DLP (Digital Light Processor) micromirror technology.

Increasing resolution while keeping the projector lamp and optics the same often results in lower brightness. With one notable exception (the much brighter InFocus unit), our measurements showed these XGA projectors to be about as bright as the SVGA group, which points to improvements in light-engine design along with the increased resolution.

Although most projectors can scale images up or down to match their resolutions, even the best show significant scaling artifacts, especially when compressing an image. For best results, choose a projector with the same native resolution as the computer it will be used with most of the time. Since most new notebooks now come with XGA displays, an XGA projector is the best match.

EPSON POWERLITE 7500C

The advantage of active matrix LCD panels is that a transistor

at each cell provides accurate control of each pixel. The downside is that this circuitry covers part of the cell and blocks the passage of some light. The 9.4-pound Epson PowerLite 7500C recovers some of that lost light by placing a minuscule lens behind every cell on the panel. More than 2 million tiny lenses are on the three 0.9-inch XGA panels in this projector, which helps the unit achieve its 800

the second brightest, at 621 lumens (which compares well with its 800 ANSI lumen specification). The Contrast Ratio score was a low 82:1, but the Brightness Variance score of 1.23 was the best of the bunch. Convergence for the three panels was excellent.

The 7500C was the only projector to exhibit any noticeable pixel defects, including a green, single-pixel bright defect. The image also showed a pronounced red tint to gray shades on the left of the screen and a



SEE THE LIGHT: Over 2 million tiny lenses help brighten the 7500C's screen.

green tint to the gray shades on the right side, and we noticed strong streaking and ghosting. In video playback, we saw strong cross-hatch scaling artifacts. The sound system has bass, treble, and SRS surround-sound controls, but these had a narrow effective range; in general, sound quality was fair.

The Epson PowerLite 7500C is best suited for computer presentations, and it's bright enough to be used in all but the most demanding settings.

Epson PowerLite 7500C. List price: \$9,999. Epson America Inc., Torrance, CA; 800-463-7766; www.epson.com.

INFOCUS LP435Z

With its 1,000 ANSI lumen brightness specification, the InFocus LP435z (\$6,999 list) is rated brighter than most projectors weighing up to twice as much—and it's 2 pounds lighter than the other projectors we reviewed here.

The LP435z uses DLP micromirror technology, and the XGA panel actually increases the amount of area used to reflect light. The projector also uses a four-color wheel to illuminate the panel, which gives a further boost to the brightness.

The projector comes with a

ANSI lumen rating. The extra technology comes at a premium cost: The Epson PowerLite 7500C carries a \$9,999 list price, making it the most expensive projector in the group.

The 7500C comes with a soft case and a lens cap that's tethered to the case, so it's hard to lose. A quick-start card makes setup easy, but the pretty on-screen menus are tricky to use at first. The manual zoom is handy, but the optics have a relatively long throw, so you'll have to place the projector farther from the screen.

An automatic picture-adjustment feature works well for size and tracking, but we had to make a minor adjustment to the horizontal position. You'll also find an excellent digital zoom-and-pan feature that lets you enlarge portions of images.

The remote control includes most standard features, plus a few more. You can add a pointer to the screen, draw lines or rectangles, highlight portions of the screen, and then clear the annotations with a push of another button.

On our tests, the 7500C was

PERFORMANCE TESTS

LCD Projectors



The lumens measurement—the total amount of light that reaches the screen—gauges the brightness of each unit. Our test procedure sets the images to display a broader range of color shades than the ANSI test protocol, which is one reason that our scores tend to be lower than manufacturers' ratings.

The Contrast Ratio indicates the difference between white and black in the image. The Brightness Variance indicates the difference between the brightest and dimmest measured points on the screen when projecting an all-white image (for this test only, low scores are best; 1.00 is a perfect score).

To create the test images used in this evaluation, we used Sonera Technologies' Displaymate (www.displaymate.com).

▲ High scores are best

▼ Low scores are best

Bold type denotes first place.

	Lumens ▲	Contrast Ratio ▲	Brightness Variance ▼
Epson PowerLite 7500C	621	82:1	1.23
InFocus LP435z	948	196:1	3.27
NEC MultiSync LT81	532	197:1	2.00
3M MP 8725	542	94:1	1.31



ILLUMINE: The LP435z has the highest lumen measurement by far of the group.

So long as the uneven lighting is not a deterrent, the InFocus LP435z is the brightest projector of the group. InFocus LP435z. List price: \$6,999. InFocus, Wilsonville, OR; 800-294-6400; www.infocus.com.

NEC MULTISYNC LT81

The NEC MultiSync LT81 is the only SVGA projector in this roundup, and it squeaks in under the weight limit at 9.9 pounds. The unit also is

LOW PRICE, LOW RES:

The inexpensive LT81 is the only tested projector with SVGA resolution

the least expensive in the tested group, at \$4,000 street.

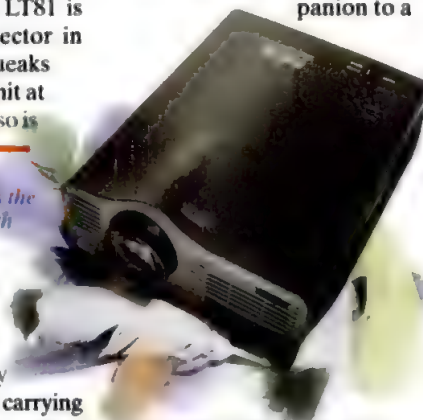
The LT81 comes fully loaded, from the soft carrying case to the remote control with a laser pointer. There is even a remote infrared mouse feature that you can plug into your computer, which lets you control your computer with the remote. NEC offers an optional feature (\$400 street) that allows you to store PowerPoint presentations on a PC Card and play them back without a computer.

Based on DLP technology, the LT81 is rated at 800 ANSI lumens. We measured the unit at 532 lumens, which is a little lower than expected for a projector with this rating. As with other DLP projectors, the 197:1 Contrast Ratio measurement was excellent, but the LT81 was weak on screen uniformity, with a score of 2.09.

The automatic picture adjustment required additional manual tweaking, and even that didn't eliminate all pixel jitter. Color tracking was fair, with an olive-green tint in evidence on darker gray shades. We observed no pixel defects and only slight ghosting, but the lack of brightness uniformity was easy to see.

Video images showed some posterization in facial tones and some visible scaling and interlace artifacts. The sound system has no tone controls, and though it had a limited maximum volume, sound was not distorted when the volume was turned up all the way.

The NEC MultiSync LT81 may not have the resolution of the other three projectors, but it would make a useful companion to a



laptop with SVGA resolution. NEC MultiSync LT81. Street price: \$4,000. NEC Technologies Inc., Itasca, IL; 800-632-4636; www.nectech.com.

3M MP 8725

The 3M MP 8725 (\$6,400 street) just makes the weight cut, at 9.8 pounds. The projector uses three separate 0.9-inch polysilicon active-matrix LCD panels to create its images.

DOUBLE DUTY: The MP 8725's RGB inputs let you connect it to two computers at once.

Although most projectors in this range are streamlined for personal use, the MP 8725 has a pair of RGB inputs so you can connect it to two computers at once. Like the other projectors in this group, it also accepts S-video and composite video signals.

The lens includes manual zoom and focus, and the projector comes with a handy lens cap

for extra protection. The full-featured remote control even includes a laser pointer.

On our tests, the MP 8725 measured 542 lumens, which is similar to other projectors rated at 700 ANSI lumens, and its Contrast Ratio was an acceptable 94:1. The Brightness Variance measurement was 1.31, but there were noticeably tinted areas in the corners on an all-white image.

The projector had no apparent pixel defects, and in spite of the lack of an automatic picture adjustment feature, there was remarkably little pixel jitter. But the image was difficult to focus sharply, perhaps due in part to the fact that the red, green, and blue panel images did not converge precisely. We also saw pronounced ghosting on high-contrast images and an olive-green cast to dark gray shades.

For video playback, we found that the projector was somewhat weak. The sound system had plenty of volume, but we discovered that overdriving it is easy and results in distortion. The speakers provide a thin sound, and the unit does not come equipped with tone controls. Video images are marred by cross-hatch scaling artifacts and posterization of continuous

tone colors. The 3M MP 8725 is better suited for



data projection applications than video, but its main attractions are its laser remote and dual RGB inputs.

3M MP 8725. Street price: \$6,400. 3M, Austin, TX; 800-328-1371; www.3m.com/meetings.

limited-feature remote control and a USB connection that can be used for control. The manual zoom is a welcome improvement over prior models in the LP400 series.

Connections are made through the included Mini Cable Wizard, which results in just one cable between computer and projector. The LP435z also comes with a lens cap and a soft carrying case, and the CD-ROM manual makes an excellent traveling reference.

On our tests, the projector was measured at 948 lumens, nearly matching its specifications. As expected from DLP models, the Contrast Ratio measurement was a crisp 196:1. The one area in which the projector did not improve on prior models was uniformity. The score of 3.27 indicates that some portions of the screen were more than three times as bright as others. The center of the image was significantly brighter than the edges, creating a vignetted effect.

The menus were relatively easy to use, and though some adjustments were required, the resulting picture showed no pixel jitter. Images were rather weak on the darkest gray shades, with a slight olive tint to dark grays. We also saw noticeable streaking and ghosting.

The LP435z was the best of the group for video projection, however, with smooth continuous tones and few visible scaling artifacts. The sound system was a bit tinny, but the bass and treble controls were effective.

The 5-mode intelligent flash with red-eye reduction offers two slow synchronization settings for creative flash photography. You can also add an external flash or other lighting equipment.

Switch to manual for ISO, spot metering, exposure compensation, white balance and aperture or shutter preferred shooting. Or just point and shoot automatically. Smile!

The 35-105 mm 3x optical lens gives you the equivalent of up to 260 mm when combined with the digital/telephoto feature. Wow!

You'll never run out of film again. The 8 MB reusable SmartMedia™ Card that's included holds up to 122 pictures.

Removable SmartMedia Cards are floppy disk compatible with the optional FlashPath™ Adapter.

The menu offers a smorgasbord of easy-to-use options that include panorama, burst shooting and macro modes.

Forget what you're doing? Check the control panel. It's that easy.

You'll have all the pixels you need to make 8 x 10 inch or larger, photo-quality prints suitable for framing.

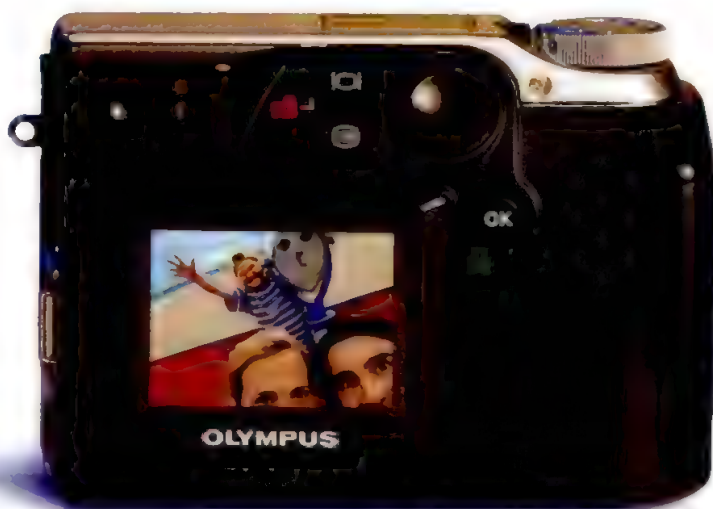
Use the infrared remote control that's included to put yourself in the picture. (Unless, of course, you prefer your own unique perspective.)

The threaded lens barrel lets you add lens adapters that provide a 29-450 mm equivalency. You can add filters, too.

The fast, f2.0, large aperture, all-glass, aspherical 3x zoom lens system looks even more impressive after you see the pictures.



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OLYMPUS
Focus On Life

Let PC Technology Be Your TV Guide

The ReplayTV 2003 and TiVo PTV 100 can make your TV experience more personalized and controllable than ever before.

By Bruce Brown

New digital TV-recording devices, the ReplayTV 2003, from Replay Networks (\$899 direct), and the TiVo PTV 100 (\$698 direct), deliver much more functionality than any VCR, but they're even simpler to set up and use. You can replay, pause, and fast-forward live television shows; automatically update channel listings; schedule recordings easily; and create custom channels with your preferred content. We found that extra personalization features and a lower price make the TiVo the better buy.

These are more than just digital video recorders. The Replay and TiVo each can record up to 14 hours of television content using MPEG2 format, and both include lifetime service subscriptions. Both devices capture personal profile information, though this never leaves either device to inform others of your preferences.

Neither device includes or accepts a keyboard, mouse, floppy disk or CD-ROM drive, parallel port, or serial port. Both systems use 14GB Quantum QuickView hard disks for recorded content; dual-drive models are also available. Cleverly designed remote controls can be trained to control your television and other AV components.

The Replay and TiVo have coaxial, S-video, and composite video input and output jacks for incoming television signals and for outgoing television or video monitor signals, and outputs for a VCR for program archiving. You can record and watch—but not copy—content protected by

Macrovision encoding. Each has an internal modem with an RJ-11 jack; the systems make periodic toll-free calls for schedule and software updates.

You can use the Replay and TiVo with any antenna, cable, or satellite source. Setup is similar for both: Hook up the cables and wires, select your television service provider and level of service from online prompts, and wait while the system downloads channel and con-

television schedule updates for your area for live viewing or future recording with a single remote-control click. The devices let you schedule single programs for recording or arrange to record a particular show whenever it's on. Because these devices are intended for relatively

Thumbs Up and Thumbs Down help develop your viewing preference profile.

By holding down Back and Fwd, you can control how much content you skip.

Quick Skip lets you move forward by 30-second intervals.

Define your own special-content channels with Replay Zones.



ReplayTV 2003



TiVo PTV 100

tent information. Both systems have replay support, though the Replay is quicker.

When you're catching up with live TV that you paused or are watching recorded content, you can use fast-forward mode. The Replay adds a Quick Skip button that jumps forward in 30-second intervals (convenient for skipping commercials).

You can view the downloaded

short-term storage of content, recorded content is deleted or replaced by new content by default.

REPLAYTV 2003

The ReplayTV 2003 measures 3 by 17 by 11 inches (HWD). Its remote control resembles a universal remote, with buttons for Instant Replay, Quick Skip, the live television Channel Guide, and Replay Guide (a chart of stored and scheduled record-

ing). The Replay Zone button accesses special "channels" that you define for content.

Even in the standard 1-hour-per-gigabyte mode, we found playback quality acceptable. Other modes improve playback quality incrementally but use twice to three times as much drive space. The Replay offers simplicity and ease of use—but at a higher price for a given capacity than the TiVo.

ReplayTV 2003. Direct price: \$899. Replay Networks Inc., Mountain View, CA; 800-266-1301; www.replaytv.com.

TIVO PTV 100

The TiVo's case is just a bit larger than the Replay's, at 3.8 by 17.0 by 12.5 inches (HWD). Its basic features work like the Replay's, though the TiVo lacks buttons dedicated to instant replay or fixed-length time skipping; you control the time intervals for rewinding or fast-forwarding. With the TiVo (unlike with the Replay), you can unbundle the service subscription from the hardware and pay a monthly or annual fee for the service (\$9.95 and \$99, respectively).

The TiVo gives you more personalize viewing options. Its remote control has Thumbs Up and Thumbs Down buttons you use to indicate your content preferences while watching live TV or perusing channel listings. Your preference profile organizes the incoming content stream to make suggestions for recordings and to select and record shows that match your profile.

Four compression levels come with the TiVo, but as with the Replay, the standard mode provided acceptable playback quality and is the one we'd use most often. With its lower price for the same recording capacity and its comprehensive content-listing and personalization features, we think the TiVo PTV 100 is a better buy than the Replay.

TiVo PTV 100. Direct price: \$698. TiVo Inc., Sunnyvale, CA; 877-367-8486; www.TiVo.com.

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Easy E-Forms

Version 4.0 of OmniForm, from Caere Corp., makes creating and copying forms a breeze.

By Alfred Poor

For help in achieving a paperless office, Caere Corp.'s OmniForm 4.0 (\$150 street) may be second only to e-mail. This powerful program not only tames paper forms but also makes them accessible in a range of electronic formats.

With OmniForm, you can scan an existing form and fill it out on your screen or modify it and print it out again. The form can also be exported as a Microsoft Word document to send to others. There is even a Mailable Filler, which bundles the electronic form with a runtime program so it can be filled out by users who don't have OmniForm on their systems.

Caere has also added a host of new features that would take pages to list. To start, OmniForm

now relies on the same OCR engine that was introduced earlier this year in OmniPage 9.0. Speed and accuracy have improved, along with the ability to recognize languages other than English and to see URLs and e-mail addresses as hyperlinks. Logical Forms Recognition (LFR) has also been improved, so the program can better distinguish between text and graphics.

The most interesting new features have nothing to do with paper, however. You can now save a form in HTML or DHTML format, which makes posting your form on a Web site easy; any field calculations you have defined are created in JavaScript in the form, eliminating the need to store the definitions separately at the site server. You can make the page compat-

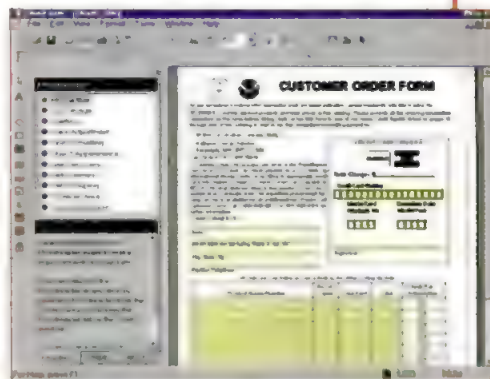
ible with Microsoft Internet Explorer 3 and Netscape 3 versions, or you can choose compatibility with Version 4 or later of both programs, which preserves field and graphic placement on the screen.

Other new features make OmniForm 4.0 a huge improvement over its prior incarnation. Its Proofreading Wizard steps you through ten different checking procedures for spelling, layout, and more. A new serial-number field lets you number forms automatically as they get filled out.

Hyperlink support, mixing portrait and landscape pages in a multipage form, and automatic font sizing in fields are just a few of the advancements that make forms design

and processing simpler than ever.

You won't completely rid your office of paper with OmniForm 4.0, but the program makes it easier to create, publish, and manage the forms



MAKE NO MISTAKES: OmniForm 4.0's new Proofreading Wizard guides you through checking a form for errors.

needed to keep any business running smoothly.

OmniForm 4.0. List price: \$149. Caere Corp., Los Gatos, CA; 800-736-5735; www.caere.com.

Natural 3-D Animation

With Bryce 4, amateurs and experts alike can animate almost every aspect of a scene.

By Luisa Simone

Among 3-D modeling programs, MetaCreations' Bryce 4 is unique in its ability to render amazingly naturalistic landscapes and worlds. This latest release adds animation capabilities that can make the earth move—along with the sun, the moon, and the clouds.

Basic keyframe animation controls are tucked away at the bottom of the main workspace and are also found in both Terrain Editor and Materials Lab. As a result, you can animate almost every aspect of a scene (such as change day to night or morph metal into glass). Experienced animators will appreciate Bryce's Ad-

vanced Motion Lab, which displays animation tracks for the individual properties associated with each object (such as position or rotation) and lets you fine-tune the duration of an event or smooth a transition.

To a large extent, though, the core functions of Bryce have not changed. The program lets you model intricate land masses by

painting simple gray-scale contour maps, and it simulates natural surfaces by combining multiple colors, optical attributes, and texture patterns.

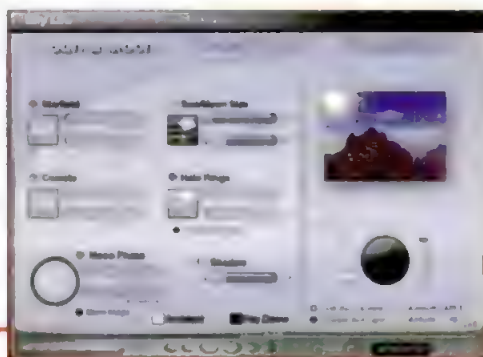
Several notable improvements include volume materials that fill the interior space of objects to create penetrable substances such as fire and localized fog, true volumetric lights that interact with one another, and atmospheric effects such as sunrises, star fields, and rainbows. In addition, the existing infinite planes (surfaces that extend to the horizon in all directions) have been supplemented with infinite slabs. Imagine a body of water that obscures objects as they sink into its depths, and you'll understand why slabs are an important addition.

Despite a friendly, icon-laden interface, Bryce 4 has many new functions that re-

quire some effort to master. We also discovered that Bryce 4's complex textures and sweeping motion effects produced minor but noticeable artifacts when compressed with standard video codecs, such as Intel Indeo 3.2. MetaCreations suggests generating movies without compression to avoid this problem.

We highly recommend Bryce 4 to anyone interested in creating fantastically detailed, ray-traced worlds. In our opinion, the deep functions of the program are the territory of professionals. But amateurs can function quite well on the surface, where choosing predefined objects and textures, executing simple 3-D operations, and creating keyframe animations are as easy as a walk in the woods. **Bryce 4.** Street price: \$200; upgrade, \$99 direct. Requires: 32MB RAM; 75MB hard disk space; Windows 95, 98, or NT 4. MetaCreations Corp., Carpinteria, CA; 800-846-0111; www.metacreations.com.

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Ultimate Trip Planning

Fast and far-ranging, Microsoft Expedia Streets & Trips 2000 will take you where you want to go.

By Bruce and Marge Brown

An integration of two earlier Microsoft Expedia products, Streets 98 and Trip Planner 98, Microsoft Expedia Streets & Trips 2000 (\$45 street, \$20 rebate through March 2000) combines North American maps, road information, and a U.S. database with 6.4 million miles' worth of street data for locating addresses and planning trips. Targeted for consumers, the program is also suitable for business use, unless you need a Global Positioning System (GPS) interface. Even so, Streets & Trips 2000 is a real bargain.

Streets & Trips 2000 includes customization tools, 10,000 Internet links, and Expedia Pocket Streets 3.0 for downloading maps to Windows CE hand-held and palm-size computers. The program comes on two CDs—one for installation and one for accessing maps and addresses. Following the well-organized menus, you can plan a route, find a place (Busch Gardens, for example), or locate an address with a few mouse clicks.

To locate an address, for instance, you enter the street number, street name, city, and ZIP code—or whatever portion of the address you can provide. In seconds, a list of choices with corresponding maps appears. In testing, the program responded quickly with accurate information, even on a relatively minimal Pentium MMX/166 with 32MB of RAM.

Once you've pinpointed a destination on the map, you can select What's Nearby? for a list of restaurants, hotels and motels, campsites, and other points of interest from 50 categories. For many locations, Streets & Trips 2000 offers articles and photos of local attractions. Internet links provide local weather,

news, events, and construction updates.

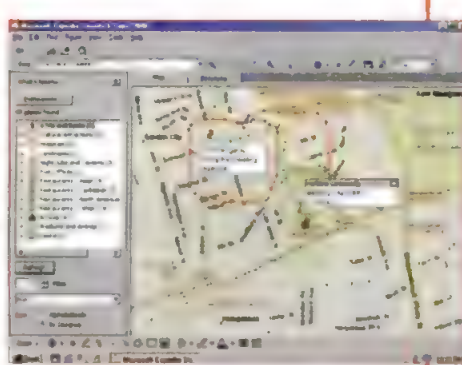
To plan a trip, you enter your preference for the quickest, shortest, most scenic, or preferred route; driving speed and hours per day; expected mileage; and fuel cost per gallon. Once you specify your starting point, end point, and stops in between, the program displays turn-by-turn directions, total mileage, fuel cost, and a map with a highlighted route.

Using the zoom slider, pushpins (256 styles), drawing tools, and map types (road, terrain, and political), you can create colorful, customized maps. You can mark locations such as clients' addresses

with pushpin labels created from imported Microsoft application files such as Outlook.

Options for printing trip maps include beginning a new page for each stop, for each day, or per designated number of miles or hours. Strip maps are a particularly helpful feature, with nine map segments per page corresponding to each driving turn. You can also print information such as highway exit services.

If you want an easy-to-use, fast, and comprehensive atlas and address locator program (and if you don't need a GPS link), Microsoft Expedia Streets & Trips 2000 is an excellent choice.



HAVE SOFTWARE, WILL TRAVEL: You can easily annotate a Streets & Trips 2000 map with text, drawings, and pushpins.

Microsoft Expedia Streets & Trips 2000. Street price: \$45. Requires: 24MB RAM for Windows 95 or 98, 32MB RAM for Windows NT 4.0 or higher, 120MB to 170MB hard disk space. Microsoft Corp., Redmond, WA; 800-426-9400; www.microsoft.com.

Faster CD-ROM Access

The new Kenwood 52x TrueX CD-ROM drive raises the bar on speed expectations.

By Alfred Poor

Two heads may be better than one, but as far as Kenwood Technologies is concerned, seven eyes are better still. Using TrueX technology from Zen Research, the new Kenwood 52x TrueX CD-ROM drive (\$130 list) sets a new standard for CD throughput.

TrueX technology takes a broader view of the CD than standard drives do. The laser beam is split by a diffraction grating into seven different beams, which are focused on the disk. These are then reflected back to a detector array that distinguishes between the beams, thus reading seven data tracks at one time.

The drive spins slower than other high-speed designs, but the throughput is much higher.

The 52x looks like any other CD-ROM drive, with an eject button, a headphone jack, and volume control on the front. The caddyless tray has clips to hold

the CD in place when the drive is mounted vertically. The drive uses an EIDE interface, with the standard cable connections and master/slave jumper positions. It's easy to install and configure.

On our tests, the 52x general-



LICKETY-SPLIT: The Kenwood 52x TrueX splits the laser beam into seven separate beams, resulting in very high throughput.

ly performed up to expectations. Using the Throughput Test from ZD CD-ROM WinBench 99 on a 628MB CD-ROM, the drive pushed through 6,742 KBps on the inner tracks and 7,471 KBps on the outer tracks. These re-

sults are close to the drive's specifications of 6,750 KBps to 7,800 KBps. As a side benefit, there was no whining siren sound, as is often heard from fast-spinning drives.

We did discover that performance may be degraded by small flaws on the CD-ROM. Using another CD that was nearly new, the results were lower by a few hundred KBps.

We also found that using the recommended computer system does not guarantee full performance. Kenwood's specifications call for a Pentium MMX/200 or higher with 32MB of RAM, but we had to flash the BIOS on one test system with those specifications before we got full speed from the drive.

The Kenwood 52x TrueX comes at a reasonable price increment over slower competitors. If you're looking for faster access to your CD-ROM data, this drive can deliver it.

Kenwood 52x TrueX. List price: \$130. Kenwood Technologies (USA) Inc., San Jose, California; 888-730-4206; www.kenwoodtech.com.

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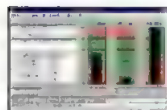


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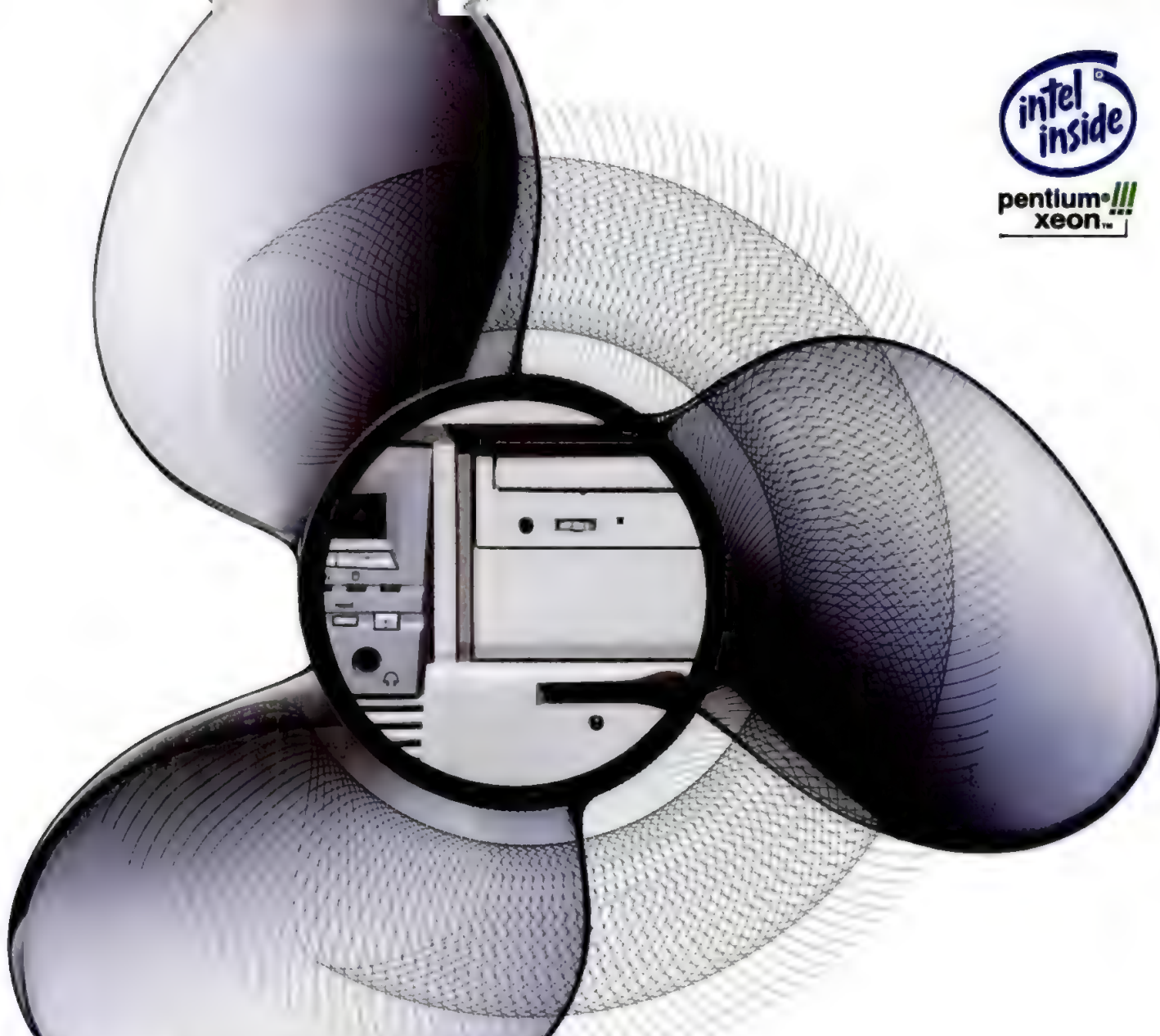
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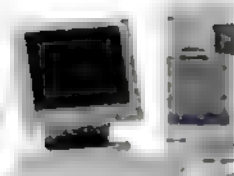
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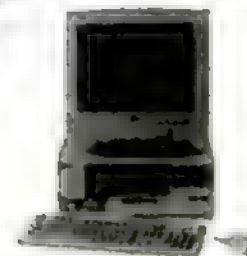
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Digital PC Speakers

Systems from Altec Lansing and Cambridge SoundWorks enhance your PC sound experience.

By Bruce Brown

Most audiophiles agree that upgrading the speakers that come bundled with PCs probably results in a better sound experience. Altec Lansing and Cambridge SoundWorks have both come up with positional digital speaker systems that can make this probability a certainty. Along with the purity of digital sound, each system offers features—including surround sound—that make them worthwhile investments.

Bear in mind that not all CD-ROM drives can output in digital. If your system has an older analog drive, you may not notice a great increase in sound quality, but other advantages with these systems include better tuning methods and controls.

ALTEC LANSING ADA-880 DOLBY DIGITAL SPEAKER SYSTEM

Do you want full digital sound—but not all the time? The new Altec Lansing ADA880 Dolby Digital Speaker System (\$329.95 list) has detachable surround-sound modules. You can switch easily from a three-component system with fewer cables for everyday listening to a five-component system with the surround modules placed behind you.

The latter gives you the accurate audio rendition required for full-immersion movie watching or bad-guy blasting. When you add 80 watts of total RMS output, crisp sound reproduction, and a remote control, this top-of-the-line PC speaker system delivers a great listening return for your investment.

The system's rear surround speakers can be used independently or combined with the front speakers. When correctly combined, the front speakers'

sound is directed to the front and the rear speakers' sound to the side, at a 45-degree angle.

AC power, satellite speaker cables, and included 80-inch analog and 120-inch SP DIF digital audio cables plug into the massive 11.3- by 15.5- by 11.5-inch (HWD) subwoofer. The front satellites, with 80-inch cables, measure 6.1 by 3.8 by 4.8 inches (HWD), and the rear satellites, with 196-inch cables, measure 4.8 by 4.6 by 3.8 inches (HWD).

The right front speaker has a volume dial and push buttons for power, bass, treble, and stereo or surround sound. The ADA880 system automatically detects analog or digital input



CLARIFY YOUR POSITION:

Speaker systems from Altec Lansing (above) and Cambridge SoundWorks deliver crisp surround sound.

and, based on the input mode, selects Dolby ProLogic or Dolby Digital surround mode, respectively.

The ADA880's 80 watts of power are split evenly—40 watts for the subwoofer and 40 watts total (10 each) for the four satellites. Frequency response is 20 Hz to 20 KHz, and the signal-to-noise ratio is greater than 70 dB. With ample power and speaker quality for normal desktop audio, the ADA880 can crank it up for game playing and can fill a

fairly large room with CD music or DVD movie soundtracks.

The subwoofer's mass pushes through a lot of air for a satisfying bass sound, and high-range sound is clear. Midrange response is more than adequate for watching movies, playing games, and listening to party-style music.

Good power and sound along with great flexibility make the ADA880 a fine buy.

Altec Lansing ADA880 Dolby Digital Speaker System. List price: \$329.95. Altec Lansing Technologies Inc., Milford, PA; 800-258-3288; www.altecmm.com.

CAMBRIDGE SOUNDWORKS FOURPOINTSURROUND FPS2000 DIGITAL

If you're a gamer who craves 3-D realism or a music lover listening for clear high tones and bass without breakup, you should consider the Cambridge SoundWorks FourPointSurround FPS2000 Digital speaker system (\$200 street). The FPS2000 is a significant step up from the Cambridge PCWorks FourPointSurround, with higher output wattage and



all-digital four-channel sound, plus a subwoofer that provides terrific bass sound.

Most attributes of the original system are beefed up with this model, including slightly larger, heavier, and more powerful components. The new system is a more stylish black; the

earlier model was white.

The subwoofer, which measures 6.5 by 8 by 13.8 inches (HWD), houses the system's four-channel amplifier for the four 3.5-inch cube satellite speakers (7 watts each) plus the subwoofer's own 25-watt amplifier. The FPS2000 also includes four table stands, two 18-inch tripod stands for optional use with the rear satellites, a volume/fader control with a 12-foot cable, and speaker cables.

To get the most from the FPS2000, you'll need a four-channel sound card that supports Microsoft DirectSound 3D with separate front and rear stereo line output jacks. The Creative Labs Sound Blaster Live! audio card, which we used in testing, is recommended by Cambridge (both were reviewed in *After Hours*, November 17, 1998). The Environmental Audio (EAX) surround sound and environmental modeling of the Sound Blaster Live! and FPS2000 system's power and clarity ably complement each other.

To test the FPS2000, we played a variety of music CDs, classical music WAV files, and Epic MegaGame's *Unreal Special Edition* 3D action game, the latter coded with support for Creative's EAX modeling. The results were all outstanding:

The high notes were icicle-clear, the bass boomed without breaking up, and the surround and environmental effects were eerily convincing.

We liked the Cambridge PCWorks FourPointSurround and thought it was a good deal. The Cambridge FourPointSurround FPS2000 has upped the ante. Although the FPS2000's price is higher, it is easy to recommend for people who want clear and realistic PC audio.

Cambridge FourPointSurround FPS2000 Digital. Street price: \$200. Cambridge SoundWorks, Newton, MA; 800-367-4434; www.hifi.com.

SEAGATE'S SIDEWINDER AIT TAPE DRIVE TRANSFERS DATA TWICE AS FAST AS THE DLT4000.

SAVING YOU ALMOST ENOUGH TIME TO JUSTIFY
READING THIS MAGAZINE.

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FYI



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Access Time	68 sec	37 sec	Accesses Data Faster

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Share the Speed

The UMAX UGate-Plus lets all of your clients share cable modem or ADSL Internet service.

By Les Freed

If you're fortunate enough to have cable modem or ADSL service in your home or office, why not share that fast connection with the other PCs on your network? The UMAX UGate-Plus Cable/ADSL Modem Sharing Gateway (\$349.99 list) is a small, easy-to-install router that provides shared Internet access for all the PCs on your LAN. You can use the UGate-Plus in your home, but several features—such as virtual servers and firewall security—will appeal to business users.

Many small networks use a software proxy server running on one Internet-connected PC to share Internet access across a LAN. Software proxy servers are inexpensive, work well, and provide a fairly complete suite of Internet protocols to the client PCs on the network, but there are drawbacks. Software proxy servers require the Internet-connected PC to have two Ethernet cards installed—one to connect to the LAN and the other to connect to the cable or ADSL modem.

The Internet-connected PC must also be powered up and running at all times. Finally, though proxy servers provide good Web, e-mail, and FTP access, they often require a special software configuration on each client PC. The UGate-Plus is an inexpensive hardware alternative that doesn't have any of the software drawbacks.

HOW IT WORKS

The UGate-Plus is basically an IP router that connects to your network and your Internet connection.

It uses the Name Address Translation (NAT) protocol to let several PCs share a single IP address provided by your cable or ADSL provider. In addition, a built-in DHCP server automatically provides IP addresses for the client PCs on your LAN. This simplifies installation and configuration by eliminating the need to configure each PC with a unique IP address.



hardware, you configure the UGate-Plus via a built-in Web server, using a Web browser from any PC on the network. If your cable or ADSL modem has a permanently assigned IP address, you must set the UGate-Plus's WAN port to use that IP address. If your cable or ADSL provider uses the DHCP protocol to assign an IP address, the UGate-Plus will use the dynamic address.

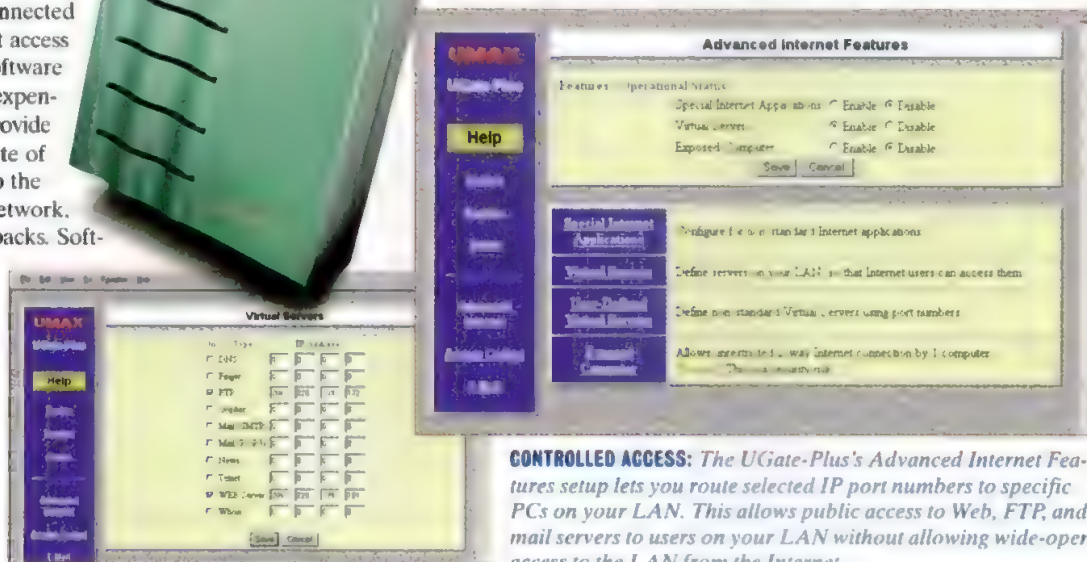
CLIENT SETUP

Assuming that your client PCs have TCP/IP installed and are configured to obtain their IP address from a DHCP server, you're finished and ready to go

Internet users access to selected servers on your LAN. This is useful if you have a Web or e-mail server on your LAN. You can designate a specific server IP address for each Internet protocol, so you could have one PC acting as a Web server while another PC handles mail or FTP requests.

We were impressed with the UGate-Plus's access-control features that let you limit Internet access to specific PCs on the LAN. (You can only control access by IP address, not by user name.) But as much as we liked the UGate-Plus, there's still room for improvement. In testing, the unit's throughput topped out at about 1.8 Mbps. Though this is adequate, the speed may present a bottleneck with a fast cable or ADSL connection. And since UMAX wants the UGate-

DIMINUTIVE: The UGate-Plus packs a lot of power into a box that's the size of a paperback novel.



CONTROLLED ACCESS: The UGate-Plus's Advanced Internet Features setup lets you route selected IP port numbers to specific PCs on your LAN. This allows public access to Web, FTP, and mail servers to users on your LAN without allowing wide-open access to the LAN from the Internet.

Like all NAT-based routers, the UGate-Plus includes firewall security for the PCs on your network, reducing the possibility of unauthorized access to your LAN from the Internet.

Hardware installation is simply a matter of plugging in the unit's power transformer and connecting the RJ-45 Ethernet connectors to your LAN hub and your cable or ADSL modem. You'll need to provide two of your own Ethernet cables.

Once you've installed the

within minutes. If the PCs on your LAN already have static IP addresses, you'll need to go through the additional steps of assigning an IP address to the UGate-Plus and configuring your client PCs to use the UGate-Plus as their default gateway.

In its default configuration, the UGate-Plus allows your client PCs to access the Internet, but it doesn't let users on the Internet access any servers on your network. If you wish, you can configure the UGate-Plus to allow In-

Plus to be used in the home as well as the office, it would be helpful if the product included a built-in 4- or 5-port Ethernet hub like other small ISDN and analog routers from vendors. If you're looking for an inexpensive way for clients on your LAN to share one Internet connection, the UGate-Plus may be for you. **UMAX UGate-Plus Cable/ADSL Modem Sharing Gateway.** List price: \$349.99. UMAX Technologies Inc., Fremont, CA; 510-651-4000; www.umax.com.

Lose the Wires

The Lucent WaveLAN Ethernet Converter expands your wireless LAN beyond just PCs.

By Les Freed

The new Lucent WaveLAN Ethernet Converter (\$295 list, plus radio card) can extend your company's wireless network to include non-PC devices such as printers, scanners, and point-of-sale terminals. In fact, the WaveLAN/EC provides a portable, wireless, 10Base-T connection to any device with a 10-Mbps Ethernet connection.

The WaveLAN/EC is a small plastic box with two RJ-45 Ethernet connectors and four status LEDs. The unit's external power supply is nearly as large as the WaveLAN/EC itself. A single PC Card slot on the side of the unit accepts any of Lucent's IEEE 802.11-compatible radio PC Cards. Lucent provided us with a standard 2-Mbps radio

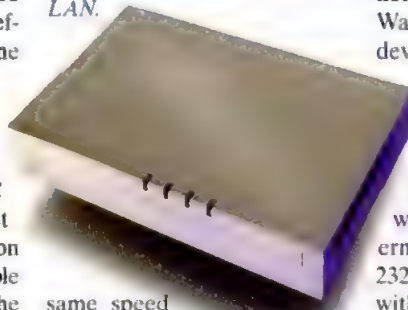
card (\$230 street) for testing, but the company's new Turbo cards should be available by the time you read this. Lucent was reluctant to share the exact speed of the new Turbo card, saying only that it "provides near-wire speeds at three-times more effective throughput" than the standard card.

This product has the simplest installation procedure of any wireless device we've tested. You insert the radio PC Card, connect the Ethernet and power cables, and you're on the air. Lucent provides a simple configuration program with the WaveLAN/EC that lets you change the unit's name, MAC address, roaming type, and wireless speed.

We tested the WaveLAN/EC with a variety of Ethernet de-

vices and encountered no problems. The device acts as a bridge, so it's completely protocol independent. We measured the WaveLAN/EC's actual throughput at about 1.2 Mbps at close range (about 100 feet) from our wireless LAN's main access point. That's about the

CONNECTED: The WaveLAN/EC lets wired devices share a wireless LAN.



same speed we've seen with other WaveLAN-based devices—and fast enough for the relatively slow devices that the unit is designed to connect.

The WaveLAN/EC fills an

important gap in the WaveLAN product line. The device is especially useful in factory, warehouse, and retail environments, since it allows users to move equipment such as printers, bar code scanners, and retail point-of-sale terminals around as needed, without running new cables or moving patch cables in a patch bay. More important for network administrators, the WaveLAN/EC lets you move devices around without any intervention from the LAN administrator.

Lucent Technologies also offers the similar WaveLAN/EC-S (\$395 list), which includes an RJ-45 Ethernet connector and an RS-232C serial connector, for use with Ethernet and/or serial devices.

Lucent WaveLAN Ethernet Converter. List price: \$295. Lucent Technologies, Murray Hill, NJ; 800-928-3526; www.wavelan.com.

Scalable CD Services

Share your data resources easily with the HP SureStore CD-ROM Server Plus.

By Greg Alwang

The HP SureStore CD-ROM Server Plus (\$4,300 list) is a Network Attached Storage (NAS) solution for sharing up to 34 CDs on heterogeneous networks. This successor to the HP SureStore CD-ROM Server offers plug-and-play setup and comprehensive browser-based administration. Built on a thin-server model, the CD-ROM Server Plus is not hindered by overloaded file servers or NOS limitations, and it presents a cost-effective solution for organizations requiring fast, reliable access to shared CD libraries.

Like its predecessor, the CD-ROM Server Plus connects as a node to an Ethernet network. This version includes six rather than seven 32X CD drives, with the seventh bay occupied by an

18GB SCSI hard disk. On the back is a fast Ethernet port and a SCSI-2 connector for attaching an optional seven-CD expansion tower.

The hard disk supports HP's Multi-Disc Cache feature for archiving copies of CDs. The hard disk also lets you cache CD directories and frequently used files for faster access. (Archiving is enabled by default but can be disabled for any CD drive.)

MULTIDISK CACHING:

It may only have six drives, but the SureStore lets you share up to the equivalent of 34 CDs.

Using Multi-Disc caching to keep copies of CDs on the hard disk, you can share the equivalent of 34 CDs; you are not limited by the number of physical CD drives.

The CD-ROM Server Plus proved easy to use, reliable, and relatively fast during testing, but we were most pleased with the ease and options of installation and configuration. Setup on Microsoft Windows Networking, Novell NetWare, or Unix networks simply requires assigning an IP address—either via a

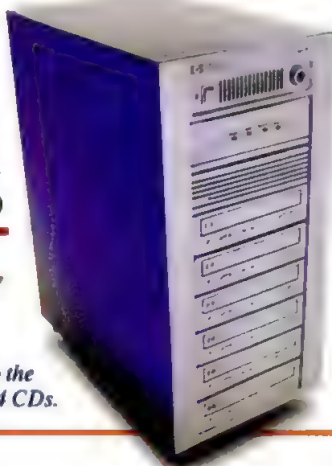
DHCP server or by manually using a simple Address Resolution Protocol (ARP) command line. The process takes only a few minutes before you can start sharing CD resources.

Once you're connected to the CD-ROM

Server Plus, remote administration is done with a browser. You can specify access rights to CD volumes and set caching options. To configure advanced access settings, a Quick Access Wizard guides you through configuration of TCP/IP, Web, Windows, and NetWare protocols. Tabbed pages provide views of CD contents, access to server and CD administration, and views of CD-ROM Server Plus event logs and usage statistics. You can limit access based on Windows NT domain or Novell NDS attributes if desired.

Unlike the Axis StorPoint CE E100 server, which is bundled and sold in other vendors' chassis, the HP SureStore CD-ROM Server Plus provides a one-vendor solution and comes with the company's two-year Express Exchange warranty.

HP SureStore CD-ROM Server Plus. List price: \$4,300. Hewlett-Packard Co., Palo Alto, CA; 800-752-0900; www.hp.com/go/surestore_nas.



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* Estimated reseller price for model 6862-29U (CPU) and 654102N (monitor). Actual prices may vary. MHz denotes microprocessor internal clock speed, other factors may affect application performance. GB = 1 billion bytes for hard drive capacity. All PCs in this ad ship with an operating system. IBM product names are registered trademarks of International Business Machines Corporation. Intel, the Intel Inside logo and Pentium are registered trademarks of Intel Corporation. © 1999 IBM Corp. All rights reserved.

SOHO Firewall Protection

Ramp Networks' WebRamp 700s keeps hackers out—and client PCs in check.

By Steve Rigney

As inexpensive cable modem and DSL connections become more prevalent, even the smallest office will soon find itself with one of these open connections to the Internet. Instead of initiating a call to check e-mail or surf the Web, these high-speed, low-cost connections are always available, which means that your PC and LAN are open to outside attackers 24 hours a day. To protect even the smallest Internet-attached network, Ramp Networks has developed the WebRamp 700s (\$479 list for 5 users). This easy-to-use unit protects not only your local resources from outside intruders, but it also lets you determine where internal users can wander on the Internet.

We found this product fairly easy to install on a very simple network. The unit is already configured with an IP address, so all you have to do to set up the Internet information is point your browser to that predefined address. Unfortunately, if you already have an IP addressing scheme, as our test network did, you'll have to change the IP address on your client PC to match the subnet of the 700s.

You can also connect one PC to the 700s and use the built-in DHCP server in the unit to lease a temporary address to that PC. Fortunately, many small LANs won't already have an IP address scheme in use, so installation should be a snap. There is also a Windows-based utility, called WebRamp Finder, to help perform the initial setup.

Though Ramp Networks is marketing the 700s to work with cable modem and DSL connections, the unit will work with any Internet router, including other WebRamp products such as the 310i. ("Shortcut to the Internet," February 9, 1999.)

The 700s uses two methods to keep outside intruders from accessing your local PCs: stateful inspection firewall and network address translation (NAT). Stateful inspection is a technology similar to what is used in enterprise-level firewall products and works by investigating the original location of an Internet packet. The stateful inspection utility in the 700s will let in data coming from the Internet only if it is part of a session that was originated by a local client, such as a Web page request.

NAT works by translating multiple IP addresses on the local network to one public ad-

dress seen by the outside. This prevents Internet users from ever seeing the IP addresses of your local PCs. The 700s can also prevent denial of service (DoS) attacks by hackers.

To prevent internal users from accessing banned sites, the 700s includes content filtering. Using the optional CyberNOT list from Microsystems, you can block outside access to 50,000 pornographic, hate, drug, or other questionable sites. You can also decide who can bypass this list based on user name and password.

Pricing for the 700s is based on the number of users. For example, a 700s that will handle 5



GUARDIAN:
The WebRamp 700s keeps intruders from hacking into your LAN and your clients from surfing banned sites.

users lists for \$479, and a 100-user unit will cost you \$1,349. Ramp Networks also offers a VPN option for \$349 for 5 users and the CyberNOT filter list for \$119 for 5 users.

Ramp Networks WebRamp 700s. List price: For 5 users, \$479. Ramp Networks, Santa Clara, CA; 408-988-5353; www.rampnetworks.com.

Get Your Net in Sync

Administer Notes, Exchange, Windows NT, and NetWare users easily with Synchronicity 2.0.

By Steve Rigney

There are two major reasons why network administrators use products like NetVision's Synchronicity. First, it allows them to establish a single log-on for multiple file and messaging systems. Second, it lets them configure user names and passwords for multiple services using a common directory tool such as Novell Directory Service.

Version 2.0 of Synchronicity (\$14 list per managed user) completes all these tasks by letting you use one program to manage Lotus Notes, Microsoft Exchange, Novell NetWare, and Windows NT users on any IPX or IP-based network. And just as the name implies, the product works by synchronizing the names and passwords of all of the users on these disparate systems. Synchronicity relies completely on

NDS as the global directory, however, so users must be running NetWare 4 or higher to use the product.

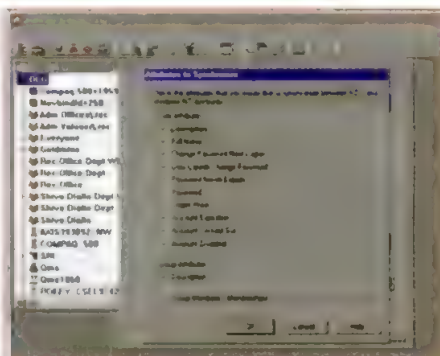
Synchronicity works as a snap-in to the Novell NWAdmin utility used to create NDS objects. With Synchronicity, we were able to synchronize all of our Ex-

proper system. If you are familiar with NWAdmin, you should have no problem using Synchronicity to manage all of your users.

Our favorite feature of the product is the ability to manage non-NDS users and systems without any interference to the respective servers. For example, Windows NT domains, including Primary and Backup Domain Controllers (PDCs and BDCs), are not changed in any way. Other products, such as Novell's NDS for Windows NT, require you to install the NetWare client, as well as special software on all of your Windows NT servers. Synchronicity doesn't make changes to your NT domains; it just imports and exports the data from and to them.

Synchronicity pricing starts at \$14 per user and drops down to around \$11 per managed user. You can also download a 30-day trial version from the company's Web site.

Synchronicity 2.0. List price: \$14 per user. NetVision Inc., Orem, UT; 801-764-0400; www.netvision.com.



ADMIN POWER: You can choose user attributes to synchronize between NT and NetWare.

change, Notes, and Windows NT users with the NDS tree. Any change we made—such as adding and removing users—automatically showed up in the

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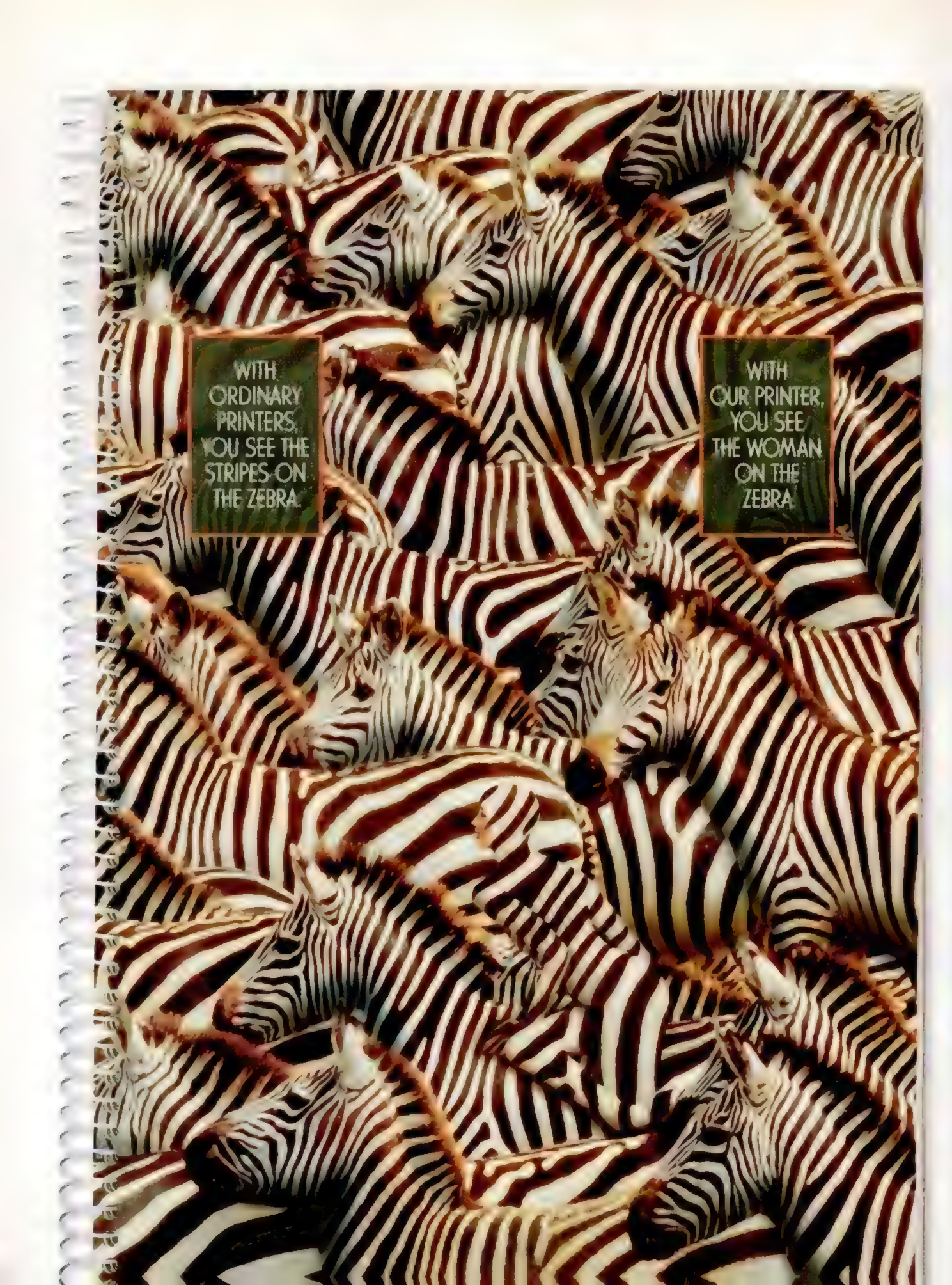
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*Estimated reseller price to end users for Netfinity 5500 M20 model 866231Y includes IBM 4.5gb Hard Disk Drive. Certain features described are available for an additional charge. Actual reseller prices may vary. mhz denotes microprocessor internal clock speed. Other factors may also affect application performance. IBM product names are trademarks of International Business Machines Corporation. Microsoft, Windows and Windows NT are registered trademarks of Microsoft Corporation. Intel, the Intel Inside logo and Pentium are registered trademarks and Pentium III Xeon is a trademark of Intel Corporation. © 1999 IBM Corp. All rights reserved.

A dense crowd of zebras fills the frame, their black and white stripes creating a complex, overlapping pattern. In the center of the image, a woman's face is subtly visible, her features defined by the negative space of the zebra stripes. Two green rectangular boxes with white text are positioned on either side of the woman's face. The entire image is set within a spiral-bound notebook cover.

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PRINTERS,
YOU SEE THE
STRIPES ON
THE ZEBRA.

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THE WOMAN
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The New Palms

By Josh Taylor

We thought that after playing with the 3Com Palm V and Palm IIIx for a couple of months, we'd come up with some profound new insights into these latest 3Com devices. At the very least, we should have been able to spot a couple of horrific flaws that would let us tell you to save your money and pick up a Palm III at bargain-basement prices. But alas, we failed.

In fact, our only revelation was that perhaps 3Com didn't go far enough in its usability testing: In an exclusive *PC Magazine* test, we discovered that it's possible to become really nauseated if you read the backlit display on the new Palm devices while traveling in the backseat of a New York City taxicab in stop-and-go rush-hour traffic.

Beyond that, there's not much to criticize. Sure, a color display would be nice. So would a voice recorder. Given the drawbacks of extra girth and shorter battery life that come with using a Windows CE device, though, we would opt for a Palm.



But are the new Palms worth anywhere from \$100 to \$200 more than the older models? (Check www.computershopper.com for the latest prices.) We think so. The improved readability of the displays alone is reason enough to shell out the extra dough. Factor in the Palm V's sleek new look and rechargeable

lithium ion batteries and we think it's not hard to justify moving all the way up. And you seem to agree.

"Initially, I was torn between the 4MB capacity of the upgradable Palm IIIx and the slim size and design of the V. But after analyzing which tools and third-party programs I use most, it was clear that 2MB is adequate for my purposes," wrote one reader. Other readers called the Palm V "absolutely incredible," saying it "more than met my expectations." One reader pointed out that there's even a third-party memory upgrade available for the Palm V. For \$249, a company called efig.com will install an 8MB up-

grade for you, though the process will void the device's warranty. (You can purchase a one-year warranty through efig.com for \$40.) The company also sells customized Palm Vs—with the 8MB card already installed—for \$649.

The bottom line? Choosing between the new Palms is a no-lose proposition. If you like having the coolest new toy on the block, splurge for a Palm V. But if you favor function over form, save yourself the money and go for the Palm IIIx. Either way, you'll get what we think is the most marked improvement: the new screen. Just don't try reading it in the backseat of a dark cab.

Tax Software Takes Off

By Kathy Yakal

As April 15 hit, the Internal Revenue Service girded its collective loins and prepared for the onslaught of last-minute tax returns; but a lot of other people breathed a major sigh of relief. The makers of tax preparation software were busy this year, and the numbers show it. Intuit announced that as of April 6, it had sold 4.1 million units of its pre-

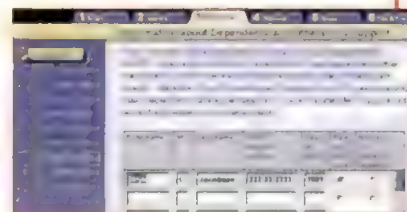
mier tax software, TurboTax (800,000 more than total sales for tax year 1997); 288,000 people have filed returns using WebTurboTax, and Intuit's Electronic Filing Center has handled more than 1.2 million approved Federal returns.

Not to be outdone, Block Financial Corp. reported an even bigger jump in sales of Kiplinger TaxCut for the 1998 tax year. Sales for December through February were nearly double the number reported for the previous year. As of February 19, TaxCut and TaxCut 1040EZ. Online users had electronically filed roughly 240,000 returns—more than triple the volume e-filed the year before. Beginning March 16 and ending April 15, Block gave away 30 free copies of TaxCut daily.

Most of your comments on using tax software programs were positive ones, such as the following: "I think choosing TurboTax over a CPA is a no-brainer. For \$25 you cannot go wrong, and filing electronically or using form 1040PC makes life easier." For many users, the ease and accuracy of the pro-

grams make them worth using.

Although there were no bugs in either program serious enough to warrant public announcements from their respective publishers, both TurboTax and TaxCut published program updates to finalize forms that the



LESS TAXING: Most users were impressed by the programs' ease of use.

IRS had not yet finalized when the programs were launched and to fix any elements of the products that were misbehaving.

IRAs—and conversions of Roth IRAs specifically—seem to have caused confusion among taxpayers this year. The IRS has reported that some 1998 returns have reported a Roth IRA conversion for certain taxpayers with incomes above the \$100,000 limit (single or married filing jointly).

Given the sales and filing numbers and the dearth of negative feedback to us this year, it's been a good year for tax software.

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I went to the expense of replacing my four-month-old Palm III with a IIIx, and I've found the device extremely worthwhile. The extra RAM is great, and the new screen is much easier to read. I've been advising each of my friends looking for a Palm device to skip the Palm III and go directly to the IIIx.

—Silk

The staff and physicians at our practice have found the Palm devices invaluable for synchronizing our clinic and surgical schedules. All the practices are networked together, and the Palms synchronize with the central iMac scheduling computer's IrDA port quickly at the end of each day. But the Palm V is our favorite—a sleek OS with targeted applications, unencumbered by generations of GUI overhead, letting us do our work faster.

—N.F. Notaroberto

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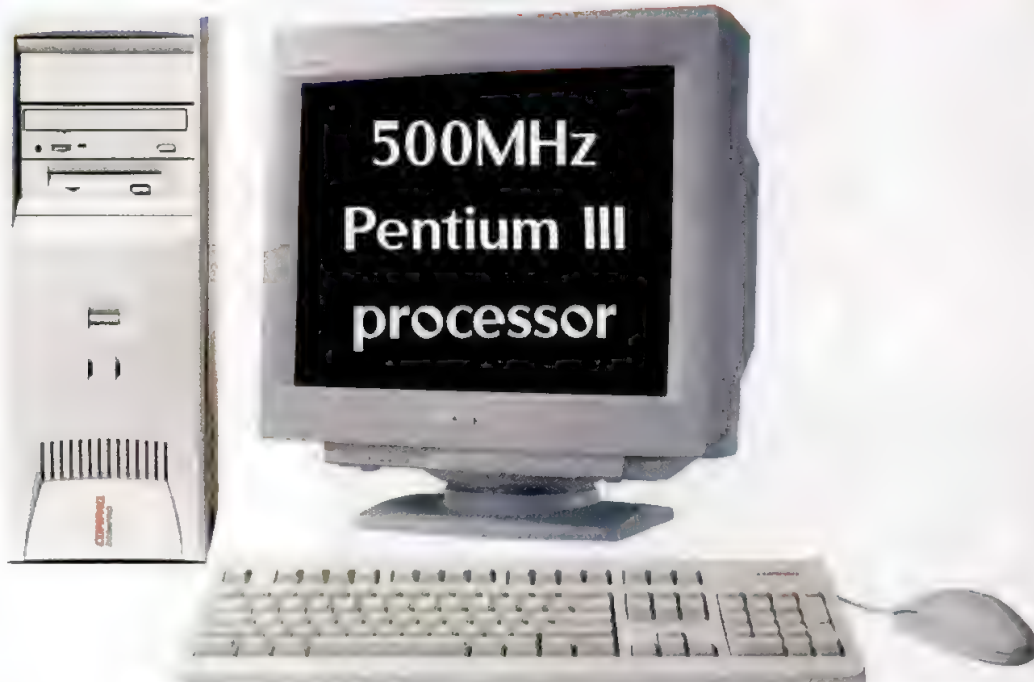
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The Floppy Replacement

Like death and taxes, you can count on regular announcements that some storage medium or another has replaced the venerable floppy disk. It does need replacing—or at least augmenting. Back in the days when 40 megabytes was a big hard disk, you could use floppy disks for backup as well as data

transfer via good old sneakernet. Today's rich content, however, demands a larger portable format, but which is the right one?

Among the challengers are CD-R, CD-RW, HiFD, LS-120, and Zip. Things you have to consider are capacity, media cost, physical size, convenience, speed, bootability, and backward compatibility. With in this list, only HiFD and LS-120 are backward-compatible, with the ability to read and write 3.5-inch disks. LS-120 is bootable, HiFD not yet. CDs are bootable on some systems, Zip is not.

One thing that you have to consider when sizing up floppy disk replacements is that floppies work. They have come a long way from the earliest days of *PC Magazine*, when we used to test disks from various manufacturers for media life and accuracy. In discussions and Talkback forums on ZDNet, I've heard pleas from readers not to mess with the floppy; floppy disks are dirt-cheap, they're reliable, and they fit in your shirt pocket. Of course you can boot your system from them, and as long as your data fits, you're in great shape.

LS-120 probably should have been the floppy's replacement. Its 120MB capacity, bootability, and backward compatibility addressed all of the main issues. But expensive drives, expensive media, and conservatism bordering on paralysis on the part of PC manufacturers (along with a healthy dose of Not Invented Here) have limited its availability and its market penetration. Ordering a system with a floppy disk drive and an Iomega Zip Drive is often easier, and you'll find a lot more Zip users to exchange files with.

The new Sony HiFD has all the outward characteristics of a winner, and it's from one of the developers of the original 3.5-inch floppy disk format. Its 200MB capacity is an attention getter, and given its parentage, backward compatibility with 1.44MB disks is a foregone conclusion. But Sony had trouble getting HiFD to work and was slow getting it into manufacturing. Worse, the first offering is a slow, parallel-port add-on that negates most of the format's benefits, undercutting an inherently speedy transfer rate and

rendering the format nonbootable. Internal versions will be along shortly, but by then it may be too late.

Last year, about two years after manufacturers said they worked, write-once CD-ROMs became practical. They also, on some systems, became bootable. CD-R (for *compact disk-recordable*) is now very hot. Media prices have dropped from \$10 to \$1. Read/write speeds are still not stellar, but they've improved steadily, to the point where we're seeing a megabit per second or better. The 650MB storage capacity is quite practical, and you have the bonus ability of being able to record music. You can't update or erase the disks, but that's a potential benefit. CD-R is a good archival medium. CD-ROM drives are ubiquitous, so anybody can read what you write. But CDs fail the shirt-pocket test.

Take CD-R and add rewriteability and you've got CD-RW. You pay a lot more for the media, but if you reuse the disks regularly you can save money. CD-RW is generally slower than CD-R, so take that into account when choosing applications.

No one is proposing that DVD or DVD-RAM is the next floppy disk, but we're seeing more and more machines—especially laptops—with DVD drives. They also read CDs, so DVD isn't a bad choice if you enjoy movies and games. DVD-RAM, however, is still a young technology. Slow and expensive, it's best suited to users who are creating content for DVD.

Then there are the outliers, such as the 340MB IBM Microdrive. Why wouldn't a matchbook-size hard disk work as a portable storage medium? The biggest problem is that it puts all the cost into the medium, not the computer.

CompactFlash and other solid-state formats are becoming a possibility, now that capacity is rising rapidly to 64MB and beyond and the price is coming down. But rotating storage, whether optical or magnetic, has always stayed ahead of solid-state's cost curve, so I don't hold much hope for this approach.

My preference? LS-120 for shirt-pocket convenience and CD-RW for capacity and flexibility. In fact, I'll take one of each. **PC**



Today's rich content demands a larger portable format, but which is the right one?

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The DOOM Factor

Now that the Littleton, Colorado, disaster has calmed down, we can seriously look at the role the game DOOM played in the death and injuries caused by the two boys who went crazy and shot up their school. Many have tried to downplay the game's role, but they're dead wrong. My conclusions do not bode well for the future.

One observer on TV called DOOM and other games "murder simulators," pointing out that the military even practices on DOOM. In fact, as I listened to various pundits discuss the role of violent games, few brought up the incredible effectiveness of many simulations.

Pilots learn to fly those jumbo jets on computer simulators, and the Army tank corps uses computer simulators to make the corps world-class. My eldest son learned to drive a car on a computer, and he's the best driver in the family. I've been using a simulator to practice skeet shooting, and last year when I grabbed a shotgun for the first time, I hit the first four birds out of the chute. The instructor called me a natural. The fact is, computers are great training tools.

There's no doubt that DOOM and other games are in fact murder simulators. If you're going to tear up a place like a maniac, you'll do a lot more damage after playing DOOM for a year or two than if you've never played the game. But so what?

I play DOOM, too. I let my kids play DOOM and Quake and Duke Nukem. I even let them play Grand Theft Auto. And yes, I know Grand Theft Auto is a simulator for carjackers. My thinking is that the boys find it fun and will move on to something else eventually. And they do. Yes, they could probably go carjacking and maybe be better at it than a kid who hasn't been playing the game. Well, if they ever become carjackers, they'll be damn good at it.

I'm convinced that there's a long stretch between knowing how to carjack (or murder, for that matter) and actually doing it. There are factors other than ability and knowledge. Martial arts classes can teach you how to kill someone, but everyone who learns martial arts doesn't go out and kill. My oldest son learned much of his driving skill on the old game Vette, where you run people over. He hasn't run anybody over in real life. He's not an idiot. This is the issue here.

There's also something called *sublimation* at work in these violent games, which has been completely overlooked in the debate. You get pooped playing

these games—especially head to head, where you're shooting at other people. The kids eventually fall back into chat rooms or strategy gaming. The amount of time you spend playing DOOM-type games naturally decreases once you get good at them and you get something out of your system. You sublimate.

The DOOM players who tore up their high school had other problems. I was personally creeped out by the school itself, which from the helicopter views actually looked like a DOOM scenario. It looked like a factory, warehouse, or prison—you decide. And the principal was an out-of-touch bureaucrat running a too-large institution.

The rationale for such cavernous, soulless schools is beyond me. They're building one in the town where I live, and I expect it to be shot up one day by a disaffected youth haunted by the daily prisonlike impersonal atmosphere. Nobody shoots up small private schools where the kids get lots of attention. For the sociology of the situation, I recommend the movie *Over the Edge* (1979). It was about a similar instance of disaffection, exacerbated by the vacuous environment of modern suburbia.

This problem is not going to go away as long as children are warehoused in a perverse environment where there are too many kids for anyone to know what's really going on. Perhaps these two jokers could have been stopped by their parents or who knows who. And perhaps the school shouldn't be held responsible, although it was the school that was shot to pieces. Whatever the case, the underlying alienation and pent-up hostility are not going away. There were sites put up on the Web that congratulated these kids—an underreported fact.

What makes this situation urgent now more than ever is the DOOM factor. This generation has been training itself on murder simulators. The disaffected youth of the past was a raw amateur who managed to kill one or two people; today's youth is essentially Rambo on the loose. I expect the body count to skyrocket in the next catastrophe and get worse and worse. Count on it.



If you're going to tear up a place like a maniac, you'll do a lot more damage after playing DOOM for a year or two.

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Read John C. Dvorak's news, views, and snide asides every Monday at PC Magazine Online. And don't miss Dvorak's "Silicon Spin" every day on ZDTV. You can also view past shows at www.zdnet.com/siliconspin.

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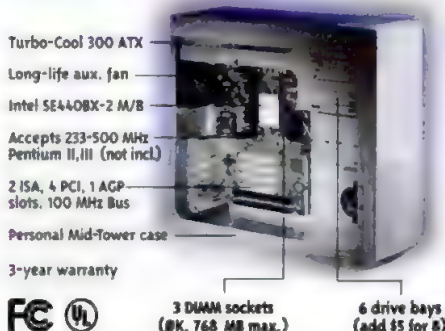
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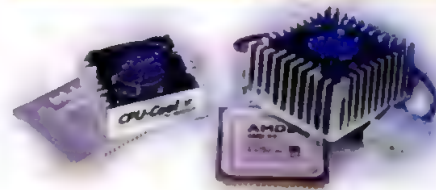
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INSIDE TRACK

Believe It when I See It Dept.: The most talked-about chip in the business is no longer the Intel Pentium III, the AMD-K6-III, or any other microprocessor we're accustomed to seeing. It's the new Sony Emotion Engine in the PlayStation II. The specifications for this chip and the things it is capable of doing are mind-boggling. This is assuming the hype is true.

The chip and new system were announced to **kill** the possibility of **Sega** making a comeback with its Dreamcast machine, which is in reviewers' hands as I'm writing this. Sony hopes to **submarine development efforts** for the new Sega platform. The plan seems to be working so far. Six months ago, all the gaming experts were **singing the praises** of the new Dreamcast machine, saying it was going to bring Sega back in a big way. That talk has stopped.

After reading *Microprocessor Report's* description of the PlayStation II CPU, **you have to wonder** whether it can be priced reasonably or even built at all: "At a whopping 240 square mm in a 0.25-micron process, the 10.5-million-transistor chip will cost more than \$100 to manufacture. Never mind the companion 279-square-mm rendering chip—or the I/O processor. The EE and GS sizes are frightening; vendors of PC processors break out in a cold sweat at the mere thought of a die size larger than 180 square mm."

The performance specifications have the chip producing **6.2 GFLOPS**, three times the PIII/500's power. The rendering speed of this thing can make it do *A Bug's Life* animations in real time. Hmmm.

There's talk that the PlayStation II will become **more than a mere game machine**. Background plans are for Sony to use it as a set-top box and desktop computer substitute by adding a keyboard and peripherals. The company may even become an ISP of sorts to encourage on-line play.

Sony has **done miserably in the computer business** but has put the computer-business management team in charge of the new PlayStation, despite the team's dubious track record. The company is going to attempt to subvert the whole desktop computer model with this powerful new unit. Good luck.

Game machines tend to sell at a loss in an effort to gain market share so the money-making games can be sold by the millions. But how much of a loss can be sustained before it actually hurts the bottom line? With two internal chips costing \$100 each, this machine will have to sell for at least \$600 to break even on manufacturing and distribution. Game machines should sell for \$199 at most.

Then there's the **rampant CD bootlegging** problem. Sony has been policing the IRC and other trading zones to prevent Internet downloads, especially of the newest games, but kids who have access to burners are copying the profitable CD-ROMs themselves. To stave

off this problem, the company could move to the DVD system, but developers who want to make backward-compatible games would be **ruined by DVD-only releases**. What to do? What to do?

Sony has already accomplished the first step in pulling this off: stopping Dreamcast's momentum by creating a buzz and FUD. Acts II and III of this drama will follow over the next 12 months. Whether the performance is **a drama or a comedy** remains to be seen.

More DSL woes. This topic is never-ending, as I'm **struggling** with the SDSL lash-up I recently hooked to. Now I have two DSL services. The newest is one of those non-phoneco services from NorthPoint, which can hit a megabit and does in fact scream—during the 50 percent uptime periods when it actually works. The first week it was down from about 11:00 P.M. to 10:00 A.M., and then on and off during the day.

The line took months to install, and at this writing it is still down daily. NorthPoint also seemed rather cavalier about service. I overheard a call from my support guy at Flashcom (the DSL ISP) to the NorthPoint call centers, which I swear went like this: "I'd like to report a problem with a customer's DSL service." "SL service?" "No, D as in David, SL." "DSL? I'll take a message." A day later, no call back.

The following day, with a tech on the line, the problem was fixed immediately. This happened in an earlier instance when the system wasn't working until it was tested. This condition, called *clear when tested*, usually indicates a problem at the central office, according to one observer, and forebodes **worsening problems**. In fact the line was down again an hour later. To be fair, friends across the Bay love NorthPoint. More to come!

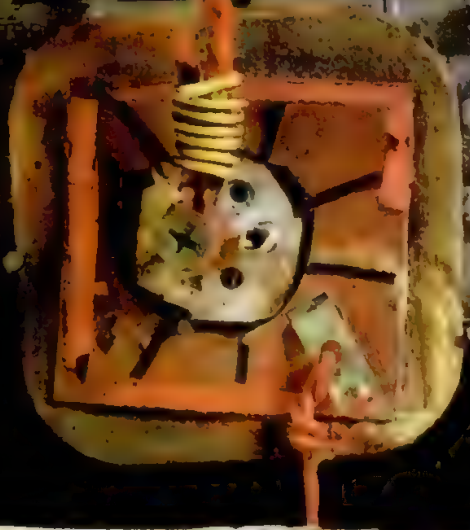
Not that the service from Pac Bell is any better. It's possibly worse, making **any DSL choice** on

the West Coast iffy. At one point, both DSL services were down. Pac Bell reported that it had a "cable failure" and wrote up a service ticket, saying it would get back to me. **No one ever did.** Worse, Pac Bell was **making claims** early on during its installation of the NorthPoint wire that my line was unsuitable. But the company's own DSL ran on the second pair of a four-line unused Switched 56 wire, meaning that Pac Bell itself was already using part of this "unsuitable" wire.

Trying to call Pac Bell's PR department was **laughable**; it seems to have been dismantled. One number was **forwarded to a disconnected number** out of the area. I had an operator verify this. Complaining to various supervisors got me two other PR and media-relations numbers, which were **also disconnected**. I gave up. **Impossible-to-penetrate voice mail leading nowhere** blockades the main office number in San Ramon. Calling the Public Utilities Commission is my next step.

No wonder AT&T is getting into the cable TV business. **PC**

*There's talk that
the PlayStation II
will become more
than a mere game
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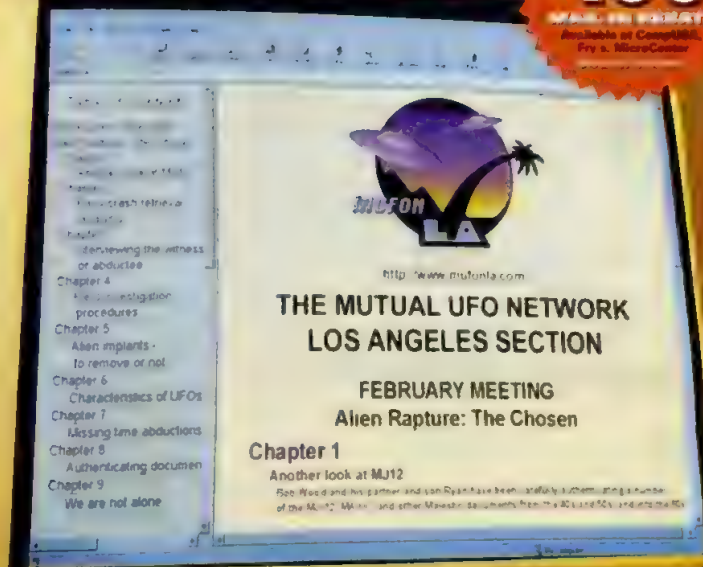


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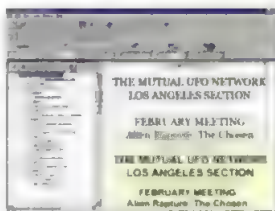
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After the Ball Is Over

"So what are you going to do when this Y2K stuff is over?" That's been my favorite question for about three months now. I've asked it of dozens of corporate computing managers, IT and MIS directors, contract programmers, and CIOs. Because while we've seen many expensive examples of the costs of

trying to fix Y2K problems in time—such as slow-downs in corporate IT purchasing, sags in the stock prices of PC hardware and software makers (especially enterprise software firms, such as Baan, i2 Technologies, and SAP), and dumped or deferred corporate development projects—most of those were one-time costs. That is, you spent a big and maybe painful chunk, but with some luck, you won't have to go on spending that money. Y2K comes, you fix the remaining problems, and then it's back to business.

But *what* business? What are businesses' priorities going to be in computing? Moving toward thin clients? Investing in Web sites for intranets, extranets, or e-commerce? Accelerating the move toward notebooks instead of desktop PCs for most employees? Replacing the aging PCs on employees' desks and in their attaché cases? Resuming put-off enterprise-level systems development and implementation?

And what's going to become of the corps of COBOL programmers and other contract employees who signed on to put out fires—when the fires are history? What about those consulting companies that have focused so intently on resolving Y2K issues?

When I began asking these questions just after the first of the year, I got a lot of funny looks. Computing managers were so focused on finishing Y2K remediation projects and getting into heavy-duty testing of their supposedly fixed systems that the notion of what came *next* was about as alien as wondering who would be president in 2020: not on the agenda yet, not even close.

But by about mid-February, the looks began to go away, and instead, I got knowing smiles. People had begun thinking and talking about the What's Next issue. They'd been polishing up their pet projects, deferred from as far back as three or four years ago, trying to get those projects back on track. And they were looking around, in what one person called "the up-periscope phase," and noticing that we're living and working in a different world now than we were when we first began Y2K planning.

Two answers dominated the replies I got: *We're going to jump on the Web, for e-commerce, business-to-business buying and selling, and maybe a more Web-centric way of working.* And: *We're going to go back and get right the things we wound up suspending part way through or things we intentionally sub-optimized and just lived with, such as our SAP R3 system.* A third answer was almost as common: *We're going to reassess our approach to outsourcing, because our use of contract people to tackle Y2K issues persuaded us that outsourcing isn't the all-or-nothing thing we thought it was. We're going to spin out a lot of projects and subprojects to contract programmers and contract program managers, who'll come in and work on-site for a while.* (And more quietly: *We'll be cutting our permanent staff substantially as we put this into effect.*)

These answers have important implications for nearly every PC Magazine reader. If your company has done a pretty good job getting ready for Y2K, you can expect to see some major changes later this year in your IT department's priorities and agenda.

- If you were pushing for a project that got derailed because of Y2K, now's the time to start getting it back on track for funding and implementation.
- If you're one of the contract programmers hired to help solve Y2K problems, your moment has arrived. Along with hundreds of thousands of your fellow contract professionals, you can expect to see greater demand for your time and talent in the years to come. (Unless you're a COBOL specialist who got back into harness for the Y2K push; I found *no* companies planning new projects in COBOL.)
- If you're an IT staffer, you should reassess your job situation and consider whether you're likely to remain in (or move to) the core group managing systems work at your company or whether you're likely to be asked to change to contract status. (I'd argue that you'll be better off in the latter situation, but those words will be cold comfort, I know, for many IT staffers. The loss of a salaried position's security, full benefits, and structure can be a seismic



You can expect to see some major changes later this year in your IT department's priorities and agenda.

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Jim Seymour

event for workers, especially those past middle age and those who've spent a long time in their present jobs.)

- If you're a worker inside or outside IT who pushed for the company to make faster, bolder moves toward the Web, you may well find moves you once saw as desirable but unlikely now become part of your job description. Those in the wilderness who saw early on how important the Net could be are being recruited to turn their dreams into corporate reality.

- And if you're a small-business person for whom all this seems a world away, you're still likely to benefit, because you'll find a corps of IT pros ready to solve your problems on a contract basis—people you'd never have been able to find or employ in years past. You won't have to look far. They'll be calling.

Some of the things no one mentioned they were going to do when I asked the What's Next question:

- Replace older computers. Not many companies are planning wholesale upgrades. They find the performance of, say, 200-MHz to 300-MHz Pentium PCs just fine, thank you; the glories of 500-MHz PIIIs are lost on them.

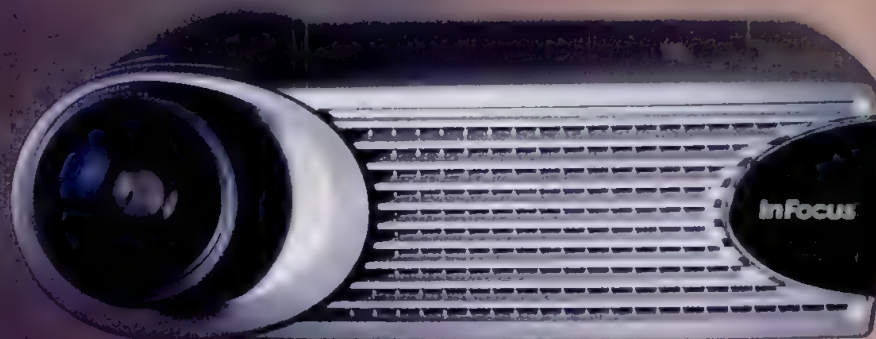
- Jump to a new OS. Whether from Windows NT 4.0 to Windows 2000 or from anything else to Linux, there's not a lot of enthusiasm (should I say not much stomach?) for going through the agonies of a systems-software upgrade. In another couple of years, maybe. In early 2000, no.

- Jump to new versions of productivity software. An Office 2000 upgrade is far from a no-brainer for most IT shops. They like what it can do, and they sometimes like its Web-centric approach—and they think it's something they can do just fine without. Come back in a couple of years, Mr. Gates.

- Push on to thin clients and the world of Java. I find almost no enthusiasm among the people who make the buying decisions for jumping to a thin-client model. Again: maybe later, but not for the next couple of years.

Slowing IT's momentum while fixing Y2K problems was a traumatic experience for most IT managers. They want a period of normalcy before they jump back on the path toward big changes. **PC**

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Palms Go Wireless

I've seen the future of hand-held computing, and it is wireless. The new 3Com Palm VII or one of its smart cousins (combining cell phone, portable Web browser, and two-way pager) is what we'll all be carrying in a couple of years. What's holding back widespread adoption today is that the devices cost

too much for non-business users, they're too bulky to be unconsciously portable, and the services cost a lot if you use them the way they're meant to be used. But these are all simple matters, solvable through technology improvements and cost reductions.

3Com's nifty implementation of wireless Internet access on the Palm VII continues the Palm paradigm of a finite features set—built around appointments, addresses, to-do lists, and notes and implemented nearly to perfection. Swing up the antenna on what looks like a standard 7-ounce Palm and all of a sudden your available information isn't limited to a snapshot of the data hot-synced off your desktop PC. Now you can find your flight's status and departure gate, the weather where you are today and where you will be tomorrow, personal and business telephone numbers, driving directions, traffic reports, stock quotes, movie timetables, a dictionary, and even the locations of the nearest ATMs and UPS drop boxes.

For the past month, I've been carrying a near-final version of the Palm VII. I've found enough value and utility to make a good case for carrying one if you're in business, but not enough for a personal user, given the cost of the unit and the service. (The unit will cost well under \$800, Palm says.) On one business trip, it was easier for me to get driving directions to my meeting from the Palm VII than to wait in line at a concierge desk. On a late-arriving flight into Chicago, the airline's grumpy employee/owner flight attendants didn't announce connecting flights: In the time between landing and filing off the plane, I was able to download my connecting flight's gate and status. I was assured that I *could* just make the final leg home if I turned left off the runway toward gate B14—and ran at full speed. I made it.

On the personal side of life, on a spur-of-the-moment night out, my wife and I checked out movie listings while sitting in a restaurant eating an early dinner. Some of the apps didn't feel fully polished yet, and others were annoying; I could look up UPS but not Airborne or FedEx drop boxes, and I could find Visa-sponsored ATMs but not my local bank's.

I could do many of these things by checking a newspaper, making a phone call, or logging on to a wired computer. But going wireless means you're not at the mercy of service-sector employees having bad days or missing phone books and newspapers. And one great Internet feature 3Com has incorporated is Web Clipping: It lets you query a Web site and extract only the information you want from the main frame, leaving peripheral frames and ads unclipped.

You can get wireless service for a Palm VII for as little as \$10 a month, but odds are you'll spend quite a bit more. The Palm uses Bell South's packet-data network, formerly called RAM Mobile Data. And the device is an adjunct to a cellular phone rather than a replacement. Although it has messaging and e-mail, the Palm VII probably can't replace a pager, because you normally turn it off to save batteries. That's why cell phone/browsers such as the Nokia 9000i and Qualcomm pdQ have potential: one device, one carrier, one bill. But 3Com is there already with a solid product.

I've also used Windows CE devices at the same time as the Palm VII. I love the color screens, but I'm disappointed by the incompleteness of these Swiss Army knife systems. Windows CE still needs at least one more iteration before it begins to feel right on a 4-inch display. That you can use these devices for mapping (the Palm can do this, too, but in monochrome), talking books, MP3 audio playback, and dictation is neat. But you pay the price in higher system costs (about \$500 for one of the better color devices) and in battery life that's still on the cusp of reaching a complete business day.

It's a vicious circle for Win CE: Because the products are wisps of what they will be, smart buyers will wait. Without a revenue stream, some of the early Win CE vendors will drop out of the business.

As Yogi Berra would say, it's not over till it's over. Microsoft started out with some mediocre products that became world-beaters; other MS products have started out poor and faded away. Too much is riding on Win CE for Microsoft to give up. But right now, the game is going 3Com's way. **PC**



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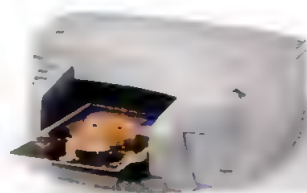
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FUTURE TECHNOLOGY

The year 2000 is upon us, and while technology has certainly advanced, our cities, our homes, our workplaces—in short, our lives—don't look much like the millennial predictions of 40 or 50 years ago. But that doesn't stop people from wanting to imagine what the future will be like, and at *PC Magazine* we're no different. In this special report, we look at the ten trends that are defining the future. • Much of the mater-

ial here comes straight from the labs where the future is taking shape. Wherever possible, we also have set up examples of these trends on our Web site, where you can try the new technologies yourself. • Some of these technologies will succeed, some will fail. Some of these trends will define technology in the decades to come, and some will undoubtedly fall short of their goals. But they all will affect personal computing in the years ahead.

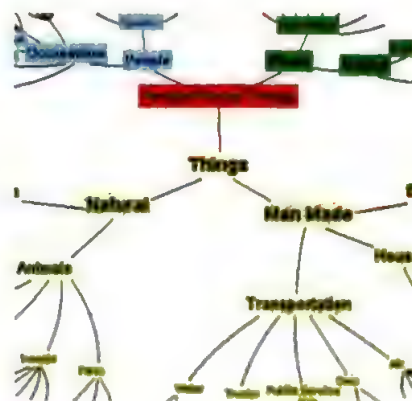
COMPUTERS WILL BE MORE HUMAN

"Computers will take on more human attributes such as the ability to react to spoken words or **written** instructions and to reply in a way that seems more natural." **Page 104.**



NETWORKS WILL BE UBIQUITOUS

"The news early in the millennium will be how this ubiquitous networking affects our work, **play**, and quality of life." **Page 114.**



THE WEB WILL BE SMART

"In the future, Web **sites** will know a lot more about you. They'll also know more about their own **content** and the content of other sites. The Web, which was built on HTML, is being rebuilt on XML." **Page 116.**

LITTLE DEVICES WILL THINK

"Embedded **processors** are multiplying at a blistering pace, relegating PC chips to mere specks in the **digital** ecosystem. Though sales of PC chips are measured in the millions, sales of embedded processors are counted in the billions." **Page 120.**

SOFTWARE WILL GET SMARTER

"Natural-language interfaces may appear to be a sign that software is getting smarter, but there are many other areas where software is becoming more human—catching up with and in some cases surpassing our capabilities." **Page 128.**

THE INTERNET ECONOMY WILL TAKE OVER

"The Internet is proving so successful at copying and then improving on the ways people shop and the ways businesses work that soon—sooner than any expert predicted—the Internet economy will be the single biggest part of the global economy's infrastructure." **Page 132.**

YOU'LL LOOK AT COMPUTERS IN A WHOLE NEW WAY

"Researchers created a display made of eight hinged, full-color polymer LCD panels. Folio folds up to fit in your pocket. Unfold it once and it's a writing pad, twice and it's a book or Web browser. Unfold it completely and it's large enough to display maps or work as a PC screen." **Page 134.**

ENTERTAINMENT WILL BE VIRTUAL

"As digital characters are becoming more lifelike, digital representations of actors are playing an increasingly larger role in Hollywood films." **Page 136.**

YOUR IDENTITY WILL BE DIGITAL

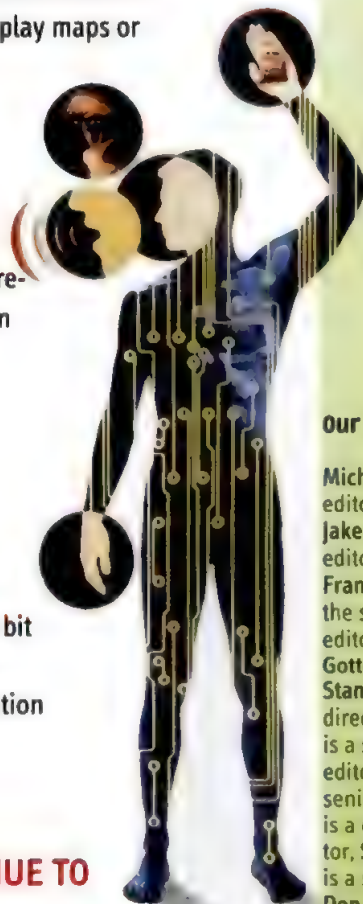
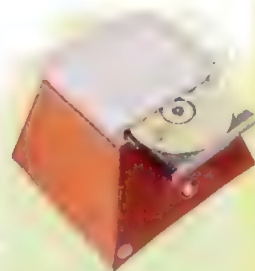
"In truth, our privacy hasn't been taken from us. We've bartered it away, bit by bit, for services and modern conveniences. Privacy in the digital age means the ability, through legal and technical means, to control information about ourselves." **Page 142.**

MOORE'S LAW WILL CONTINUE TO DRIVE COMPUTING

"You'll have a billion transistors on a chip by the year 2011—if not sooner—and your computing devices will be far more powerful than you can imagine." **Page 146.**

SPECIAL FOLDOUT: CONCEPT COMPUTERS

We take a look at the computers you might be using—or even wearing—in the not-so-distant future. **Page 151.**



our contributors

Michael J. Miller is the editor-in-chief and Jake Kirchner is the editor of *PC Magazine*. Frank J. Derfler, Jr., is the senior networking editor. Ben Z. Gottesman and Nick Stam are technical directors. Carol Levin is a senior associate editor, Cade Metz is a senior writer, Jan Ozer is a contributing editor, Sebastian Rupley is a senior editor, and Don Willmott is an executive editor. Nancy Hirsch was the associate editor in charge of this story.

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Computers Will Be More Human

..... New technologies will allow you to interact with computers much the way you would with another person, making computing a much more natural experience. By Michael J. Miller

When we say that computers will become more human, we don't mean that they will suddenly become as mobile or as intelligent as Data, the android from "Star Trek: The Next Generation." Instead, we mean that they will take on more human attributes such as the ability to react to spoken words or written instructions and to reply in a way that seems more natural. The result: A user interface that will appear much more human, even if the underlying computer program is not "artificially intelligent" at all.

The natural outgrowth of this desire to create a more human interface is to give it a bit of a personality. Done badly, this could mean an interface that is overly cute or gets in the way more than it helps. But done correctly, this could make computers and Web sites much easier and much more natural to use.

One of the first heavily publicized attempts was a market failure: Microsoft's Bob, which used a "social interface" as a front end to Windows. Bob has long since disappeared from the retail shelves, but the concept lives on in the Intelligent Assistant in Microsoft Office. Office users probably know one of these characters (be it the animated paperclip or the friendly dog), and chances are you either like the character enough to ask it questions or you hate it so much you've banished it forever.

Love them or hate them, you're likely to see a lot more of these techniques used in computer systems over the next few years. Such characters—sometimes called bots or agents—will probably become staples of many Web sites.

PCs THAT UNDERSTAND

Perhaps the most fundamental technique underlying this is *natural-language processing*, or the ability to respond to a question that is phrased the way you would phrase it to another person. One Web site that has used a natural-language interface to make it stand

out is Ask Jeeves. Unlike using a traditional search engine, you ask Jeeves a question and it gives you a list of specific questions it knows the answer to, one of which, it is hoped, holds the answer to your original question.

Ask Jeeves doesn't pretend any level of personality, but other services in this space try to create more human characters. The result is something called a *chatterbot*—a virtual character that you can ask questions of and get answers from on a particular area.

Many of you may remember Eliza, a simulated psychiatrist that just played back words and random phrases based on rudimentary analysis of keyed input to demonstrate a simplistic form of artificial intelligence. Some chatterbots have much of the same



feel—uncannily human at times and obvious and fairly useless at others. But chatterbots don't pretend any innate intelligence; they just respond to questions that match a subject they've been programmed on.

Some chatterbots, such as Neuromedia's Red, which is designed as a demonstration of a virtual customer service representative, don't appear as much more than a box into which you type text. The idea is that your customers can talk to it and get useful answers most of the time, thus cutting down on the

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- ★ harman/kardon HK-195 Speakers, add \$25.

\$1999

Business Lease¹⁵: \$67/Mo., 36 Mos.

 **E-VALUE CODE: 04098-590519a**

NEW DELL DIMENSION XPS T450 PENTIUM III PROCESSOR AT 450MHz

- 64MB 100MHz SDRAM
- NEW 9.1GB⁴ Ultra ATA Hard Drive (7200 RPM)
- 17" (16.0" vis., .26dp) M780 Monitor
- 8MB ATI XPERT 98D 3D AGP Graphics
- 40X Max⁵ Variable CD-ROM Drive
- Yamaha XG 64V Wavetable Sound
- MS Office 97 SBE plus Bookshelf (Ask about Our FREE MS Office 2000 Upgrade Offer); McAfee VirusScan
- MS Windows 98/IntelliMouse
- Dell QuietKey Keyboard
- 3-Year Limited Warranty²
- 1-Year NBD On-site³ Service
- ★ Upgrade to 96MB 100MHz SDRAM, add \$59.
- ★ Upgrade to a 17" (16.0" vis., .26dp) 1000HS Trinitron Monitor, add \$99.

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 **E-VALUE CODE: 04098-590514**

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- 3Com Palm III, add \$319.
- HP SureStore CD-Writer Plus 7200E, add \$388.

DELL DIMENSION V400c INTEL® CELERON™ PROCESSOR AT 400MHz

- 64MB SDRAM
- 6.4GB⁴ Ultra ATA Hard Drive
- 17" (16.0" vis., .26dp) M780 Monitor
- 8MB ATI 3D AGP Graphics
- 32X Max⁶ Variable CD-ROM Drive
- Yamaha XG 64V Wavetable Sound
- harman/kardon HK-195 Speakers
- 3Com 3C905B 10/100 NIC
- MS Office 97 SBE plus Bookshelf (Ask about Our FREE MS Office 2000 Upgrade Offer); McAfee VirusScan
- Microsoft® Windows 98
- Dell QuietKey Keyboard
- Logitech First Mouse+ Wheel (PS/2v)
- 3-Year Limited Warranty²
- 1-Year NBD On-site³ Service
- ★ Upgrade to a NEW 9.1GB Ultra ATA Hard Drive (7200 RPM), add \$29.

\$1299

Business Lease¹⁵: \$44/Mo., 36 Mos.

 **E-VALUE CODE: 04098-590512**

DELL DIMENSION V400c INTEL CELERON PROCESSOR AT 400MHz

- 32MB SDRAM
- 4.3GB⁴ Ultra ATA Hard Drive
- 15" (13.8" vis.) 800F Monitor
- 8MB ATI 3D AGP Graphics
- 32X Max⁶ Variable CD-ROM Drive
- Integrated Intel 10/100 Ethernet Controller
- Microsoft Works Suite 99 with Money 99 Basic; McAfee VirusScan
- Microsoft Windows 98
- Dell QuietKey Keyboard
- Logitech First Mouse+ Wheel (PS/2v)
- 3-Year Limited Warranty²
- 1-Year NBD On-site³ Service
- ★ Upgrade to the Small Business Solutions Bundle, add only \$155. NEW Dimension V433c: Intel Celeron Processor at 433MHz, 6.4GB Ultra ATA Hard Drive, MS Office 97 SBE plus Bookshelf, McAfee VirusScan

\$999

Business Lease¹⁵: \$33/Mo., 36 Mos.

 **E-VALUE CODE: 04098-590509**

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- Intuit QuickBooks 99, add \$118.
- Intuit QuickBooks Pro 99, add \$215.
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DELL DIMENSION AWARD INFO

- In 1998, Dell Dimension desktops won more than 90 product and service awards. See www.dell.com/awards98 for details.

Advertised configurations vary from award-winning configurations.

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Business Lease¹⁵: \$127/Mo., 36 Mos.

 **E-VALUE CODE: 04099-890537**

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- 14.1" XGA Active Matrix Display
- 64MB SDRAM
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- Lithium Ion Battery
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- NEW Microsoft Windows NT[®] Workstation 4.0/Touchpad
- 3-Year Limited Warranty²

\$2799

Business Lease¹⁵: \$90/Mo., 36 Mos.

 **E-VALUE CODE: 04099-890527**

NEW DELL INSPIRON 7000 A300LT PENTIUM II PROCESSOR AT 300PE MHz

Desktop Features, Notebook Convenience

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- 32MB SDRAM
- 4.3GB⁴ Ultra ATA Hard Drive
- Removable Combo 24X Max⁷ Variable CD-ROM and Floppy Drive
- 2X AGP 4MB ATI RAGE LT Pro 3D Video
- 3D Surround Sound with Wavetable
- Lithium Ion Battery
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- Microsoft Windows 98/Touchpad
- 3-Year Limited Warranty²
- ★ 56K Capable¹¹ Gold Card Global Modem, add \$139.

\$2399

Business Lease¹⁵: \$80/Mo., 36 Mos.

 **E-VALUE CODE: 04099-890523**

DELL INSPIRON 3500 A300GT PENTIUM II PROCESSOR AT 300PE MHz

Light Weight, Light Price

- 14.1" XGA Active Matrix Display
- 32MB SDRAM
- 4.3GB⁴ Ultra ATA Hard Drive
- Modular 24X Max⁷ Variable CD-ROM
- NeoMagic[®] 256AV AGP Video
- 3D Surround Sound with Wavetable
- Lithium Ion Battery
- Microsoft Works Suite 99 with Money 99 Basic
- Microsoft Windows 98/Touchpad
- 3-Year Limited Warranty²
- ★ 3-Year NBD On-site³ Service, add \$99.
- ★ Upgrade to 64MB SDRAM, add \$99.

\$1999

Business Lease¹⁵: \$67/Mo., 36 Mos.

 **E-VALUE CODE: 04099-890519**

NEW DELL INSPIRON 3500 C333XT INTEL[®] CELERON[™] PROCESSOR AT 333MHz

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- Lithium Ion Battery
- Microsoft Works Suite 99 with Money 99 Basic
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- ★ 3Com[®] 10/100 Fast Ethernet Adapter, add \$129.

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Business Lease¹⁵: \$60/Mo., 36 Mos.

 **E-VALUE CODE: 04099-890517**

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Network-Optimized Notebook

- 13.3" XGA Active Matrix Display
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- Modular Floppy Drive
- NeoMagic 256AV AGP Video
- 3D Surround Sound with Wavetable
- Lithium Ion Battery
- MS Office 97 SBE (Ask about Our FREE MS Office 2000 Upgrade Offer)
- MS Windows NT Workstation 4.0/Touchpad
- 3-Year Limited Warranty²
- Deluxe Nylon Case

\$3199

Business Lease¹⁵: \$107/Mo., 36 Mos.

 **E-VALUE CODE: 04099-790531**

DELL LATITUDE CPi A300ST PENTIUM II PROCESSOR AT 300PE MHz

Network-Optimized Notebook

- 12.1" SVGA Active Matrix Display
- 64MB EDO RAM (256MB Max)
- 4.3GB⁴ Ultra ATA Hard Drive
- Modular 24X Max⁷ Variable CD-ROM
- Modular Floppy Drive
- NeoMagic 256AV AGP Video
- 3D Surround Sound with Wavetable
- Lithium Ion Battery
- MS Windows NT Workstation 4.0/Touchpad
- 3-Year Limited Warranty²
- 1-Year NBD On-site³ Service
- ★ Upgrade to 96MB EDO RAM, add \$99.

\$2399

Business Lease¹⁵: \$80/Mo., 36 Mos.

 **E-VALUE CODE: 04099-790523**

DELL NOTEBOOK AWARD INFO

- Inspiron 7000 A366LT — PC Magazine's Editors' Choice for small businesses, 1/99.
- Inspiron 3500 C300XT — PC World's Best Buy in the budget category, 4/99.

Advertised configurations vary from award-winning configurations.

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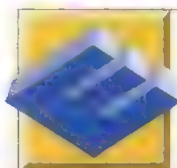
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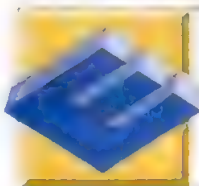
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Business Lease^{1b}: \$414/Mo., 36 Mos.

E-VALUE CODE: 04100-290501

DELL POWEREDGE 4300 SERVER PENTIUM II PROCESSOR AT 400MHz (DUAL PROCESSOR/RAID CAPABLE)

- 256MB 100MHz ECC SDRAM
- 9GB¹ Ultra-2/LVD SCSI Hard Drive (Hot-Swap Optional)
- HP OpenView NNM Special Edition
- Two Intel Pro/100+ PCI Ethernet Adapters with Adaptive Fault Tolerance Software
- Integrated Ultra-2/LVD and Ultra/Narrow SCSI Controllers
- Redundant Hot-Swap Power Supplies, Cooling Fans and Processor Fans
- 12/24GB Variable SCSI DAT Tape Backup Unit
- 6 Expansion Slots: 4 PCI, 2 PCI/ISA
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- 3-Year NBD On-site³ Service
- 1-Year DirectLine NOS Support
- 7x24 Dedicated Server Hardware Technical Telephone Support

\$5949

Business Lease^{1b}: \$199/Mo., 36 Mos.

E-VALUE CODE: 04100-290559

DELL POWEREDGE 2300 SERVER NEW PENTIUM III PROCESSOR AT 500MHz (RAID 5 CONFIGURATION)

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- HP OpenView NNM Special Edition
- Intel Pro/100+ PCI Ethernet Adapter
- Integrated Ultra-2/LVD and Ultra/Narrow SCSI Controllers
- 6 Expansion Slots: 4 PCI, 2 PCI/ISA
- 6-1" Hard Drive Bays
- 4 Media Bays: 3-5.25", 1-3.5"
- 3-Year NBD On-site³ Service
- 7x24 Dedicated Server Hardware Telephone Technical Support
- ★ APC Smart-UPS 700W Power Supply, add \$369.

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Business Lease^{1b}: \$184/Mo., 36 Mos.

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DELL SERVER AWARD INFO

- Network World "World Class Award" – Dell PowerEdge 2300, 6/98.
- Computer Shopper "Top 100" – Dell PowerEdge 2300, 11/98.
- PC Computing's "The 'A' List" – Dell PowerEdge 6300, 11/98.
- LANTimes "The Best of LANTimes Over \$25,000" – Dell PowerEdge 6300, 9/98.
- ComputerWorld's "Leaders' Choice" Winner Workgroup Servers – Dell PowerEdge Family, 1/98.

Advertised configurations vary from award-winning configurations

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DELL POWEREDGE 2300 SERVER NEW PENTIUM III PROCESSOR AT 450MHz (DUAL PROCESSOR/RAID CAPABLE)

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- 9GB¹ Ultra-2/LVD SCSI Hard Drive (Hot-Swap Optional)
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- HP OpenView NNM Special Edition
- Intel Pro/100+ PCI Ethernet Adapter
- Integrated Ultra-2/LVD and Ultra/Narrow SCSI Controllers
- 6 Expansion Slots: 4 PCI, 2 PCI/ISA
- 4-1.6" or 6-1" Hard Drive Bays
- 4 Media Bays: 3-5.25", 1-3.5"
- 3-Year NBD On-site³ Service
- 7x24 Dedicated Server Hardware Technical Telephone Support
- ★ 12/24GB Variable SCSI DAT Tape Backup Unit, add \$749.

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Business Lease^{1b}: \$127/Mo., 36 Mos.

E-VALUE CODE: 04100-290537

DELL POWEREDGE 2300 SERVER PENTIUM II PROCESSOR AT 400MHz (DUAL PROCESSOR/RAID CAPABLE)

- 64MB 100MHz ECC SDRAM
- 4GB¹ Ultra-2/LVD SCSI Hard Drive (Hot-Swap Optional)
- HP OpenView NNM Special Edition
- Intel Pro/100+ PCI Ethernet Adapter
- Integrated Ultra-2/LVD and Ultra/Narrow SCSI Controllers
- 6 Expansion Slots: 4 PCI, 2 PCI/ISA
- 4-1.6" or 6-1" Hard Drive Bays
- 4 Media Bays: 3-5.25", 1-3.5"
- 3-Year NBD On-site³ Service
- 7x24 Dedicated Server Hardware Technical Telephone Support
- ★ MS® Windows NT Server 4.0 (10 Client Access Licenses), add \$799.
- ★ Upgrade to a Pentium III Processor at 450MHz, add \$300

\$2349

Business Lease^{1b}: \$79/Mo., 36 Mos.

E-VALUE CODE: 04100-290523

NEW DELL POWEREDGE 1300 SERVER PENTIUM II PROCESSOR AT 400MHz (DUAL PROCESSOR/RAID CAPABLE)

- 64MB 100MHz ECC SDRAM
- 4GB¹ Ultra-2/LVD SCSI Hard Drive
- HP OpenView NNM Special Edition
- Intel Pro/100+ PCI Ethernet Adapter
- Integrated PCI Ultra-2/LVD SCSI Controller
- 6 Expansion Slots: 5 PCI, 1 PCI/ISA
- 4 Hard Drive Bays: 2-1.6" and 2-1"
- 3-5.25" Media Bays
- 3-Year NBD On-site³ Service
- 7x24 Dedicated Server Hardware Technical Telephone Support
- ★ Upgrade to a 9GB Ultra-2/LVD SCSI Hard Drive, add \$200.
- ★ Upgrade to 128MB 100MHz ECC SDRAM, add \$122.

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Business Lease^{1b}: \$62/Mo., 36 Mos.

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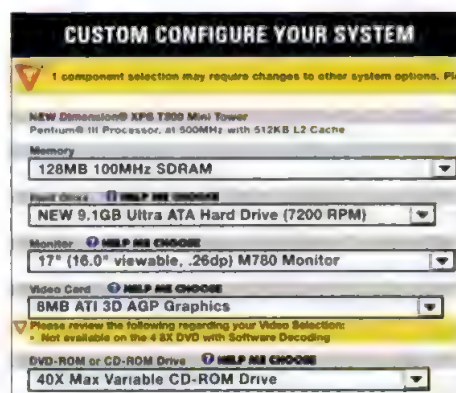
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time they spend on the phone waiting for a human representative. Ask Red "Are you intelligent?" and it will reply: "Smart, yes. Intelligent, no. I don't reason; I just match patterns. It only seems like I'm intelligent because humans would have to reason, or think, to answer these questions."

Other companies are going for a more human approach. One example comes from Big Science Co. The demo of its Klone Server, Andrette, not only replies to your questions but shows different pictures of the character as well. Ask it "What does Big Science sell?" and it will reply: "Big Science Company creates Klones like me. Can I give you a short tour of this site?" Ask it "Are you married?" and it replies: "Only wetware engages in rituals of gene mixing. Not me."

When natural language or a chatterbot is used as a way of controlling an application, the result is what some call a social interface. NetSage has developed several of these, including its Social Intelligence Server. Using NetSage's languages, companies develop systems that act as sales or support representatives, stock brokers, mortgage assistants, or teachers. Examples of the Social Intelligence Server include the Office Assistants in Office 97 or the voice user interface for General Magic's Portico virtual assistant.

VOICE RECOGNITION

Another method of creating a more human interface is voice recognition, which is improving at an amazing pace. Already products like Dragon NaturallySpeaking and IBM's ViaVoice are doing a reasonable job of continuous-speech recognition. Today, such products are limited by the need to speak punctuation such as "period" or "comma," but that limitation will soon be overcome.

A lot of work is also being done toward eliminating the time users must spend training the software to recognize their voices, making these programs truly speaker independent. IBM's head of speech development, David Nahamoo, notes that "as devices get smaller and smaller, you need to change how you interact with them." He demonstrated software you call over the phone that answers and directs your questions based on your response, without any training required.

In fact, many researchers are working on such telephone-based systems. Victor Zue of MIT's Laboratory for Computer Science has been working with what

he calls *speech understanding* systems designed for specialized functions. He notes that most households don't yet have Internet access, but nearly all have telephones, so he views voice as a way of bringing new applications to more people. Among the systems that Zue and LCS have created is Jupiter, which uses speech understanding to answer your questions about the weather over the phone (888-573-8255). Other projects in the works include a mapping application and a system that gives out airline information.



UNDERSTANDING EMOTION

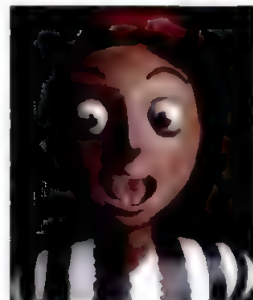
What if a computer could begin to understand what you're feeling? MIT professor Rosalind W. Picard, head of the Media Labs' Affective Computing Group, is developing a system that will do just that. Physiological sensors attached to your body and tiny cameras that record your facial expressions let the computers monitor your reactions. Then an "affective tutor" will adjust a program to react to your emotions. For instance, if you're confused by a complex part of a video lecture, the tutor could play it back to you or offer an explanation.

Perhaps the machine itself could express emotion. MIT has developed Bruzard, an interactive animated 3-D character designed to look like a small child. It uses facial expressions to react to your questions. In the future,

Bruzard could be hooked up to something like a chatterbot to create a more human interface.

Microsoft Research has combined many of these ideas into a concept called Flow. James Kajiya, assistant director of Microsoft Research, believes computers should be about giving you back your time. Thus Flow, which is still in the research stage, will allow you to sit at your computer and take part in a virtual meeting. Lifelike avatars would represent you and your coworkers so it would look much like a traditional meeting, even though everyone might be in different locations. And the entire conversation would be recorded and converted to searchable text for later use. One of the big challenges, Kajiya says, is modeling human attention, so that you could pay attention when you wanted to and not when you didn't have to.

These techniques are a long way from the mainstream. But the combination of animation, natural-language processing, voice recognition, and voice synthesis may very well result in user interfaces that seem more natural than anything we have today.



1. Bruzard, an MIT research project, could put a human face—one that would express emotions—on your PC.
2. Big Science's Andrette will answer your questions about Big Science Co. and give you a tour of the site.

Networks Will Be Ubiquitous

..... In the future, high-speed network connections and internet access will be the norm, affecting everything you do. **By Frank J. Derfler, Jr.**

- The kids in the back seat will have a flat-panel display for Web surfing, games, and movies. [A]
- In front, a touch-screen LCD will include car controls, e-mail, a navigation system, and phone. [B]

In the future, networking will be simultaneously invisible and ubiquitous. We'll have incredibly fast wired networking at home and in the office, and high-speed services connecting us everywhere. The two areas of networking technology in uproar right now, fast access and home LANs, will calm down by the end of 2000 and assume their places as part of the utility system. The news early in the millennium will be how this ubiquitous networking affects our work, play, and quality of life. The benefits of being universally connected are

delivery of raw materials, fast shipping of finished products, efficient access to funding, and better personnel management. Improvements in connectivity will reduce the need for office facilities and for packaging of products that are better delivered online.

Lately, the networking action has been out in the wide area network that underlies the Internet and corporate intranets. More developments are still in the works. Internet2, an umbrella of programs that link the efforts of industry, government, and academia, is the biggest incubator for WAN technology. A backbone of Internet2 known as Abilene spans over 10,000 miles of fiber-optic cable and operates at 2.4 Gbps, with the potential for 10 Gbps. More than 70 universities and research facilities are expected to connect to Abilene by the end of 1999.

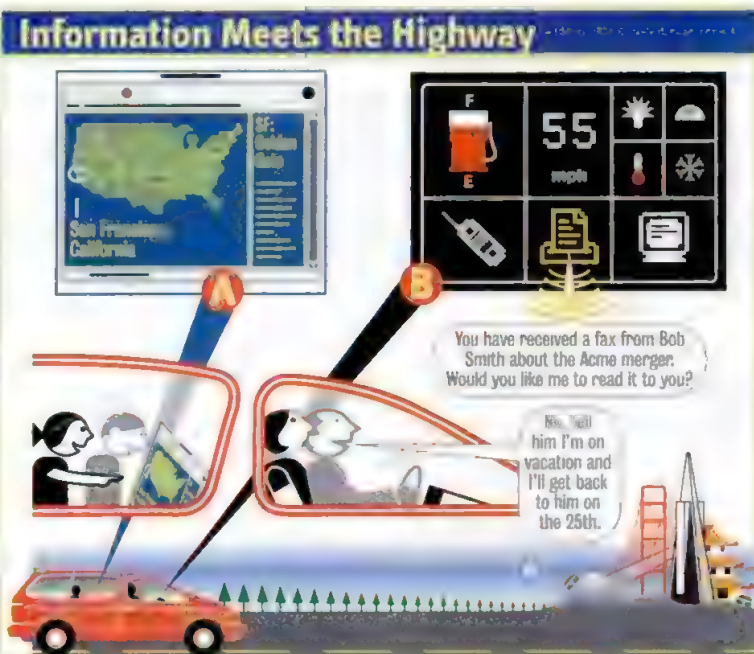
One immediate goal of WAN development is to do something about the Internet Protocol (IP). The current version of IP, IPv4, was headed for a crash into obsolescence, but techniques such as network address translation (NAT) saved it by relieving the pressure on the number of available IP addresses.

The more pressing problem is that IP doesn't tell you enough about the data it transports. A growing Internet needs both greater numbering capacities for more nodes and more flexibility to set priorities for categories of data. IPv6 provides these features, but it needs extensive seasoning before people will trust it to carry the load of Internet and intranet traffic.

This year will be one of massive deployment of digital subscriber line (DSL) connections to businesses. Cable modems will continue to add new home subscribers. But both technologies will run into limitations on distance and the cost of installing new copper connections.

The years 2001 and 2002 will see the bloom of *fixed-point wireless*. Fixed-point wireless uses microwaves to carry high-speed data above the ground-bound connections of fiber and cable television, and it's practical to deploy even in rural areas. Cable modem, DSL, and wireless will all find their niches.

The portable wireless market will explode even sooner. Today's wireless market is a confused muddle. Cell phone-based digital technologies nudge against those meant only for data. Starting in 2000, heavy competition between technologies for browser-equipped phone connections will split the market but create more features and lower prices. By 2002, Internet-connected telephone/pager/browser devices will be widely available and affordable.



- Radar-based adaptive cruise control will maintain a safe following distance.
- Seeing-eye cameras and embedded roadway transponders will steer the car.
- Smart sensors in run-flat tires will eliminate the need for spares.

more efficient commerce and a more comfortable life. Automobiles provide an excellent example. At the highest levels, the automobile industry is deploying the world's largest virtual private network, and an increasing number of private auto sales take place over the Internet.

At the hardware level, we're already deeply into the era of computer-assisted driving. A modern automobile is a network of dozens of processors interconnected with dozens of sensors. In a growing number of cities, we can breeze through tollbooths that scan our cars, and automated fuel pumps will bill us quickly and efficiently as well. The tightly connected world becomes ever more adaptive and helpful. The downside is that the connected world can gather and sell more information about you.

In commerce, tight connectivity allows just-in-time

Illustration by
Nigel Holmes

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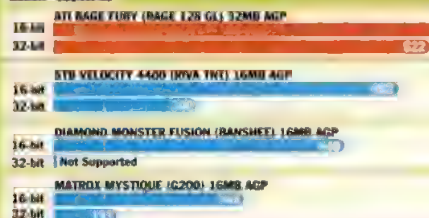


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..... The Internet is a vast repository of information, but the Web will soon be able to anticipate as well as deliver the precise information you need. *By Sebastian Rupley*

Let's face it, the Web is pretty dumb. This isn't surprising, considering that all the Web was originally designed to do was display text (and later graphics) on any computer. In the future, Web sites will know a lot more about you. They'll also know more about their own content and the content of other sites.

MAKE IT PERSONAL

The Web's most widespread trend is toward personalization. You've seen this at personal portals such as My Excite, My Yahoo!, and My ZDNet. In these examples, the applications aren't smart; the users are. Users customize the information by telling the site which categories they care about, which stock prices they want to track, which city they want the weather for. More

look at what you say you like and compare it with what others like. It can then recommend products or services recommended by others with similar tastes. All sorts of sites now offer some amount of this kind of customization, from book recommendations at Amazon.com to music reviews at Launch Media.

Direct Hit brings a slightly different version of this idea to Web searching. When you're looking at the results of a Web keyword search, Direct Hit points you to the site that the most users have visited. This

"popularity" technology is now used by sites like HotBot and ZDNet. If you search for the word *Elvis* on HotBot, for example, you'll receive the ten sites most frequently visited by previous HotBot users making the same request.

Another trend making the Web seem smarter is the proliferation of *bots* or agents. In particular, we're seeing lots of bots tied to Web sites, querying other sites to help you, say, find the lowest price on a particular product. Eventually you may well have your own agents

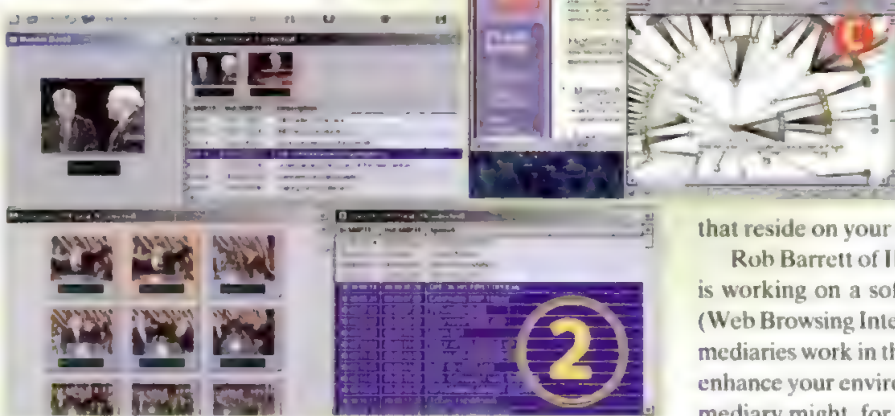
that reside on your computer.

Rob Barrett of IBM's Almaden Research Center is working on a software *intermediary* called WBI (Web Browsing Intelligence). Similar to agents, intermediaries work in the background to "customize and enhance your environment," Barrett says. The intermediary might, for example, automatically retrieve and install a plug-in you need to view a Web page.

FROM HTML TO XML

For the Web to give you the information you want, sites must be able to understand other sites' content. Today, XML (for eXtensible Markup Language) is emerging as the technology to do just that. HTML provided the language to define the layout of text and graphics on a page. XML, on the other hand, is not a presentation language but a common way of describing data. Thus it will enable not only more precise searching, it will let businesses share data more efficiently. In short, the Web, which was built on HTML, is being rebuilt on XML.

Like HTML, XML grew out of the Standard Gen-



1. IBM's WBI brings agent technology to your desktop.

WebPlaces [A] is where surfers can interact. The Personal History [B] provides access to Web pages. A WBI-generated map of the IBM site [C] 2. Use Virage's VideoLogger to search video content by such criteria as scene cuts and camera pans.

and more. Web sites are becoming aware of their visitors and customizing the information they provide for each one.

Today, sites track visitors by giving them log-on names and passwords or cookies that are stored within the browser. The next step is for a Web site to customize its information without your explicitly telling it what you want. In the future, sites will track what you tend to look at and offer it to you without your intervention.

Collaborative filtering is another technology that makes sites appear smart. With software from such companies as Firefly Network (recently acquired by Microsoft), Net Perceptions, and Andromedia (which offers its LikeMinds personalization service) sites



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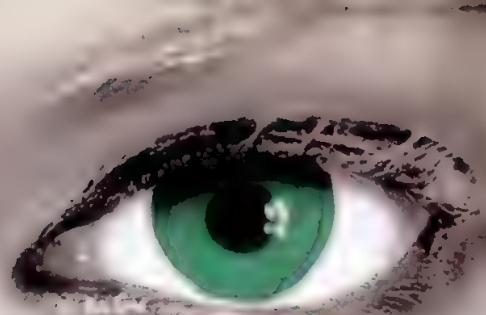
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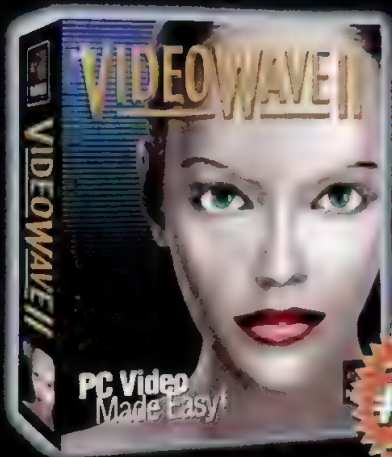


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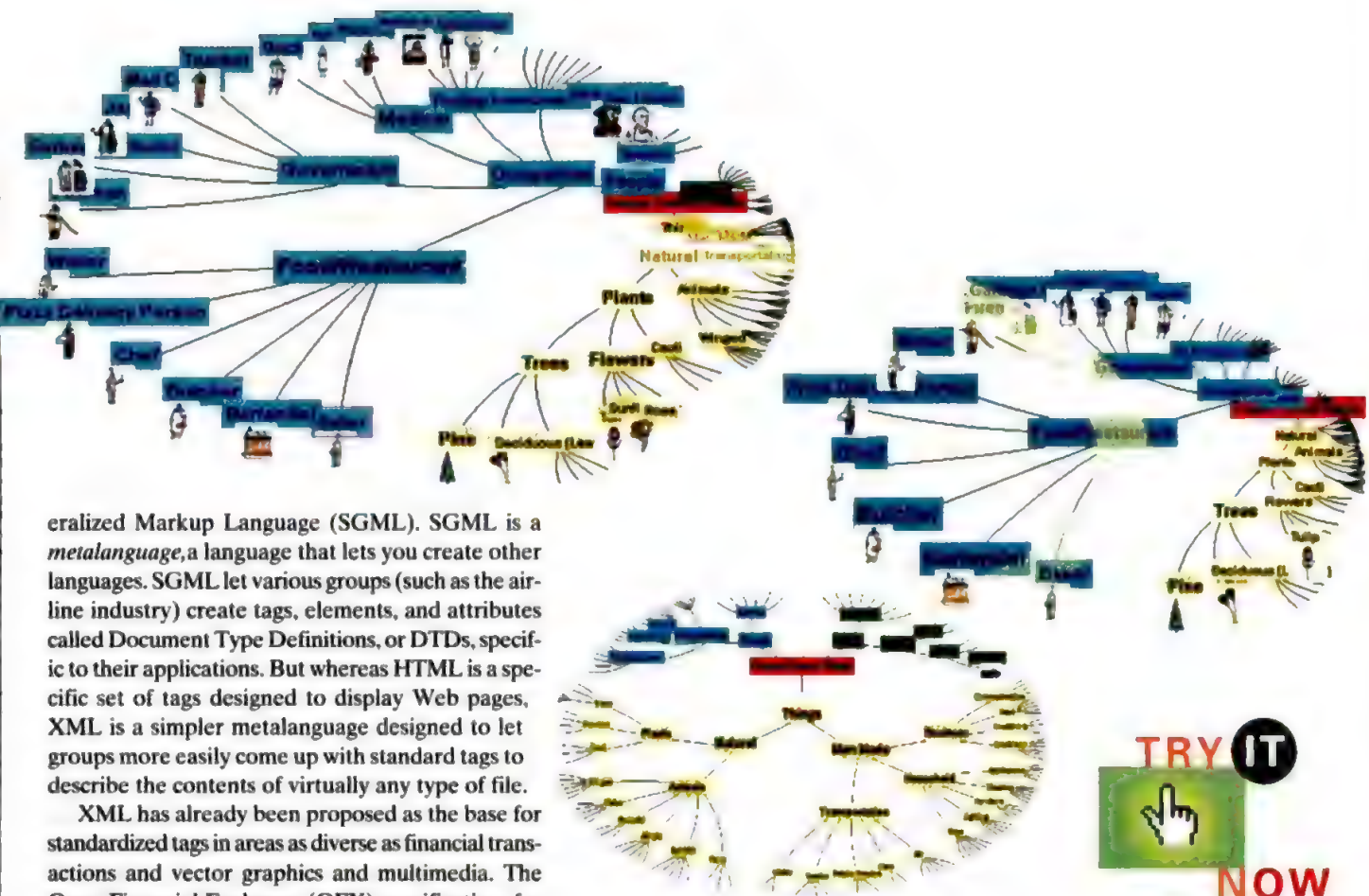
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eralized Markup Language (SGML). SGML is a *metalanguage*, a language that lets you create other languages. SGML let various groups (such as the airline industry) create tags, elements, and attributes called Document Type Definitions, or DTDs, specific to their applications. But whereas HTML is a specific set of tags designed to display Web pages, XML is a simpler metalanguage designed to let groups more easily come up with standard tags to describe the contents of virtually any type of file.

XML has already been proposed as the base for standardized tags in areas as diverse as financial transactions and vector graphics and multimedia. The Open Financial Exchange (OFX) specification, for example, provides a common set of tags that will let customers manage their finances and pay bills online. It should let businesses exchange records about bill payment, meaning many more businesses will be able to accept online transactions. And XML is a standard, so almost any software can be adapted to work with it. The real promise of XML is in letting applications of all kinds—from databases to e-commerce software—exchange data on the Web intelligently.

In the future, XML is likely to be used in a lot of ways, and not just on the Web. In Office 2000, for example, Microsoft is supporting XML as an alternative file format, so you can store Microsoft Word or Excel documents as files that can be viewed in any XML-compliant browser. Yet you can still edit the document in its original program.

BETTER SEARCHING

One area XML may improve immediately is Web searching. Because XML tags describe information in a document, the descriptions themselves can be searched, letting you get more specific. Aeneid Corp. uses XML tags and sophisticated text retrieval to find and correlate related information at multiple sites.

Most search engines today just look for text. But as more and more multimedia content becomes part of the Web, the ability to search through the vast sea of information will be necessary for it to be useful. Virage's VideoLogger is designed for coding and

accessing video content. Virage is working with Web sites and producers of video content to let users search through video for such things as specific spoken words. Meanwhile, IBM has been looking at a technique called *Query By Image Content* (QBIC), which organizes and searches a database of images using color, shape, and texture rather than just keywords.

Many efforts to change user interfaces are also underway. Inxight's Hyperbolic Tree, for example, looks like a globe of hypertext links that a user can navigate spatially, via a mouse. A Hyperbolic Tree user might remember that one previously read Web link was down near the equator on the globe, while another link was closer to the north pole.

Natrical's The Brain organizes Web-based information via a spatial interface. Similar in look and feel to Hyperbolic Trees, The Brain is designed to be a medium for sharing content over the Internet without the need for a dedicated Web site to store the information. The Brain creates *associative structures* to relate a group of files to one another, just as your own brain associates many pieces of information.

When we combine all these new approaches—from personalization, bots, and new search techniques, to better ways of navigating Web sites—we're going to move from a Web that has a lot of data to search through to one that brings the information we want directly to us.



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Little Devices Will Think

.....Starting the dishwasher from your cell phone or having your refrigerator order your milk online may seem far-fetched now, but it won't for long. **By Carol Levin**

Manufacturers of all sorts of home appliances are building more smarts into their wares with the help of embedded processors with names such as Strong-ARM and DragonBall running obscure operating systems such as pSOS and VxWorkx. You won't see multimillion dollar Super Bowl commercials promoting the processors, but these no-name chips—over 120 varieties from some 40 companies—are positioned to reinvent computing for the new millennium.

You already benefit from many of them every day. They're hidden inside microwave ovens, washing machines, set-top boxes, and other assorted peripherals of modern life. The fastest-growing destinations for embedded chips are video games, digital cellular phones, and automobiles.

Technically, there's not much difference between some low-cost embedded processors and pricey Intel Pentiums, except that embedded processors cost less and consume less power. "There are embedded chips that would give the Pentium II a run for its money," says Jim Turley, senior analyst at MicroDesign Resources (MDR) and senior editor of *Microprocessor Report*. Technological advances may start showing up in embedded processors before they do in conventional ones. John Hennessy, dean of Stanford University's School of Engineering and cofounder of MIPS Computer Systems, says embedded chips may be first to offer multiple processors on a single chip. And they are multiplying at a blistering pace, relegating PC chips to mere specks in the digital ecosystem.

Though sales of PC chips are measured in the millions, and although annual growth hovers around 15 percent, sales of embedded processors are counted in the billions, with annual growth at 50 percent last year and 100 percent the previous year. "Conventional processors make up roughly 0 percent of the world market," says Turley. Last year, 250 million high-end (32-bit or 64-bit) embedded processors shipped; that's one for every man,

woman, and child in the U.S. You get the picture.

Consumers' hunger for embedded chips has become insatiable. Just consider the success of the Palm family of hand-held devices, the latest of which run on Motorola DragonBall EZ chips. And there's lots more to come, as hardware manufacturers eagerly show off prototypes and discuss concepts of even smaller devices that break the bounds of traditional computing.

PHONES, WATCHES, AND FRIDGES

At IBM, one of the latest prototypes to come out of the lab is the cyberphone, a combination cellular phone and computer with wireless Web access and a tiny built-in virtual display on which, thanks to a mirror, images appear as large

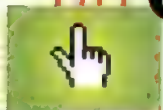
as they would on a desktop monitor. IBM engineers are also noodling with a super-high-resolution wristwatch that can provide easy visual access to data. And wrist phones have already hit Asia, where Samsung sells a model with voice-activated dialing that should be available in the U.S. next year.

Symbian (the consortium of Ericsson, Motorola, Nokia, and Psion) has developed the EPOC operating system for running the next generation of Internet devices. Symbian has kept a low profile, but it has been striking deals left and right to get EPOC inside future devices. The Ericsson R380 GSM mobile phone, which should be available early next year, will run EPOC and include a built-in modem, PDA, touch screen, calendar, address book, e-mail, Internet connection, handwriting recognition, voice dialing, and voice answering. But Microsoft wants Windows CE to be inside your Internet devices, and the company recently demonstrated the Hermes Internet telephone, which runs Windows CE.

Smarter microprocessors are also finding their way into refrigerators. A prototype refrigerator from Frigidaire Home Products and ICL, which uses an Intel microprocessor, offers such mouthwatering items as 32MB of RAM, an Ethernet connection, a flat-panel touch screen, a bar-code scanner, and Microsoft Windows 95. Once the fridge is connected



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When the Cat's away, the Mouse can't Play...



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Some observers, including MDR's Turley, are bearish about such network appliances, relegating them to technologists' dreams. Instead, Turley sees embedded processors improving on existing technology. Your dishwasher, for example, will become quieter with the assistance of an internal computer that deadens the sound.

COMMUNICATION IS KEY

So how exactly will you start your dishwasher while you're at the office? After all, neither your phone nor your PC even knows that your dishwasher exists. Both Microsoft and Sun Microsystems think they have the answer. Each company is backing its own initiative to get all these new appliances and gadgets to become aware of each other and communicate in much the same way as your telephone communicates with any other telephone in the world.

For Sun Microsystems and the many manufacturers of cellular phones, printers, and hand-helds it has recruited, the answer is Jini, a Java-based technology that deposits Java code on digital devices so they can self-organize into communities without a desktop computer to act as an intermediary. Devices that support Jini can join a network, automatically configure themselves without fuss, and start communicating. Jini doesn't require any particular operating system or processor.

Competing directly with Jini to become the common language for all digital devices is Microsoft's Universal Plug and Play. If everything goes as planned, it will be built into every device in your digital universe, so you'll be able to connect your WebTV to a scanner and e-mail photographs from your television. Or perhaps you'll need to turn off the stove from the car by using your digital phone to access the home network. No problem. And if you can't be home to let the cable guy in, you'll be able to tap into the video camera and let him in remotely.

Universal Plug and Play uses standard Internet protocols, so when you connect a device to the network, the device automatically acquires a TCP/IP address and, using a "discover protocol" based on HTTP, announces its availability to other devices on the network. No PC required.

But Universal Plug and Play is just one step



toward Microsoft's far more ambitious Millennium research project, which aims to turn a network of devices into one giant computer that allocates resources efficiently to accomplish each task. Whereas Universal Plug and Play provides a way for devices to communicate, Millennium "takes all those devices and makes them look like one big computer," says Microsoft researcher Galen Hunt. What Millennium does is comparable to talking to your friends, whether they're standing next to you or on the other side of the planet, without even knowing a phone is involved," says Hunt.

Motorola, a leading embedded-chip manufacturer, also has ambitious plans for smart appliances. It recently teamed up with MIT's Media Lab to create the Motorola DigitalDNA Laboratory, where future smart and appliances are already under development. DigitalDNA refers to the possibility of linking together all sorts of smart products. Some of the concepts include a treadmill that automatically checks your pulse and adjusts the incline accordingly, clothing with labels that inform the washer what cycle to use, and doors that open for specific people or pets.

And that's just the beginning. Whichever protocol wins out for connecting all these devices together, there's a good chance that it won't matter to you. Just as you don't think about what OS your telephone runs, you won't care what OS or chip your digital devices run. They'll just be there, at your service.

- 1.] The Samsung CDMA watch/phone is the smallest wireless phone ever produced.
- 2.] This prototype Internet fridge from Frigidaire Home Products and ICL has Internet access and a bar-code scanner to keep track of dwindling provisions.
- 3.] The Ericsson R380 mobile phone runs the EPOC OS, designed for the next generation of Internet devices.

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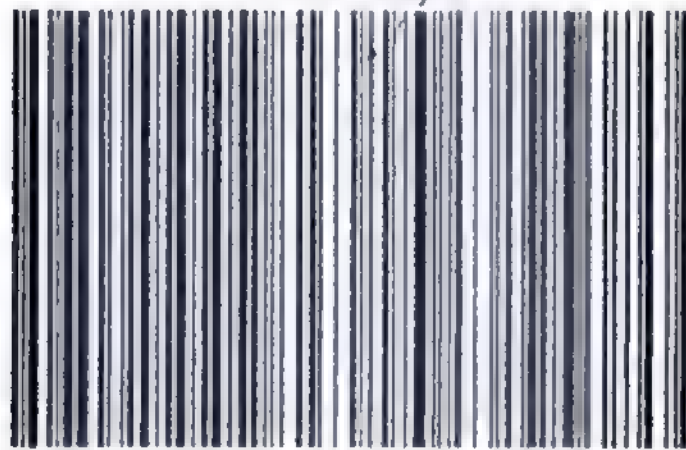
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1. Follow instructions on the other side

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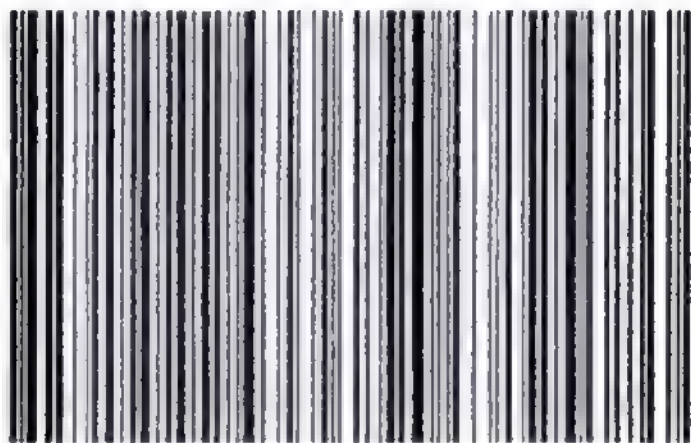
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Inverted Back

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Folded edge of the page



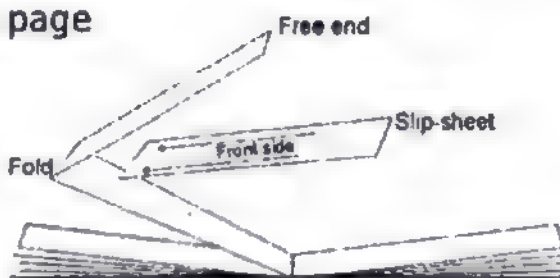
Inverted Foldout slip-sheet

Foldout slip-sheet



1. Open the foldout page
2. Insert this sheet with
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4. Close the page and slip-sheet

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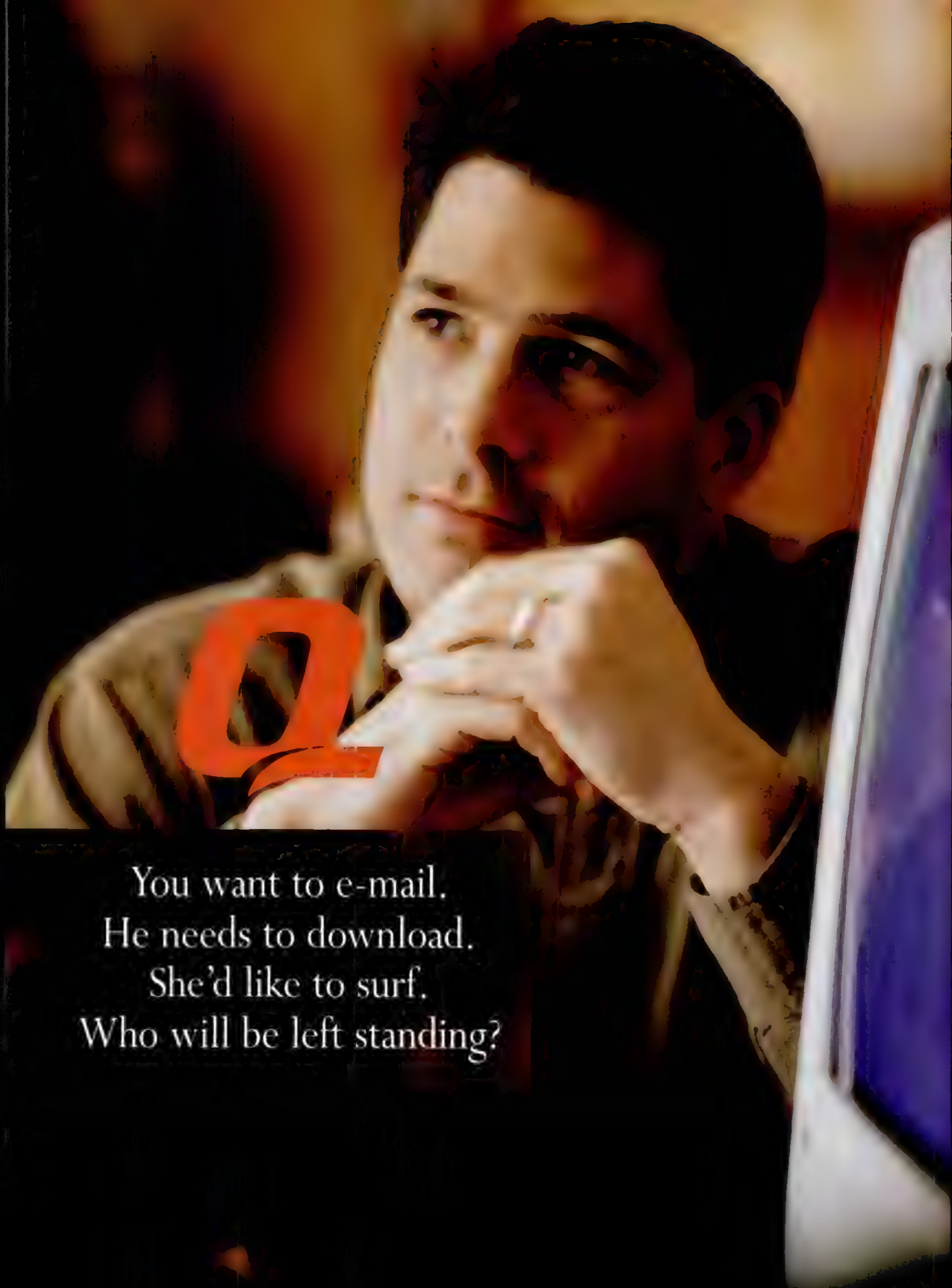
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..... With processor and memory power exploding, software that thinks for itself—or at least appears to—will become a reality. By Ben Z. Gottesman

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➤ The Age of Spiritual Machines by Ray Kurzweil
www.penguinputnam.com/kurzweil/index.htm

How many times have you heard someone, whether a novice or an expert user, complain "I wish this software were smarter"? Or perhaps they didn't use such kind phrasing. But software typically is not smart. This isn't meant as an insult to the programs, but the vast majority of the applications we use today simply react to commands we give them. As computers have become more powerful, software capabilities have grown, and in the future, we may see software that comes closer to what we consider "thinking."

NATURAL LANGUAGE

Software that appears to understand what you tell it has been around for years. In 1979, a game called *Dungeon* was developed at MIT. Users could type in phrases such as "Open the door" and *Dungeon* would tell them what happened when the door was opened.

Recently, we've been seeing a reemergence of programs that can interpret a reasonably wide range of natural-language commands. Actioneer has created a front end for Microsoft Outlook, Palm Desktop and PDAs, and Lotus Notes that lets you type phrases like "Schedule a meeting with Bob for next Tuesday at 10"; the program automatically makes the proper entry in your calendar for the correct contact. Equally interesting is General Magic's Portico, a service that performs many of the same tasks as Actioneer, plus takes messages for you, reads you your e-mail, and lets you check news and stocks all by telephone.

These applications are impressive and useful, but they only scratch the surface of what

users want in smarter software. Both applications appear to understand whatever you tell them, as long as you're asking them about something related to your mail, calendar, and contacts. Step outside this limited world and it means you're pretty much back to *Dungeon*'s "I don't understand that."

Natural-language interfaces may appear to be a

sign that software is getting smarter, but there are many other areas where software is becoming more human—catching up with and in some cases surpassing our capabilities. Consider Deep Blue's historic 1997 victory over chess world champion Garry Kasparov. Deep Blue, a highly parallel 32-node IBM RS/6000 SP computer, did not approach the game in the same way as Kasparov.

Rather than just identifying patterns in the placement of the pieces and sequence of moves as a human chess player would do, Deep Blue calculated hundreds of millions of positions per second to make the optimal move. By contrast, Kasparov only could examine approximately three positions per second.

NEURAL NET TECHNOLOGY

Mainstream computer software is also beginning to leverage humanlike pattern recognition, typically referred to as *neural net* technology, meaning that it can "learn" from experiences. The continuing improvements in optical character recognition, speech recognition, and even face recognition can be attributed in large part to neural nets.

These examples show that there's evidence of computers getting smarter, but some time will pass before software is considered an across-the-board match for humans. In his book *The Age of Spiritual*



Illustration by
William Duke

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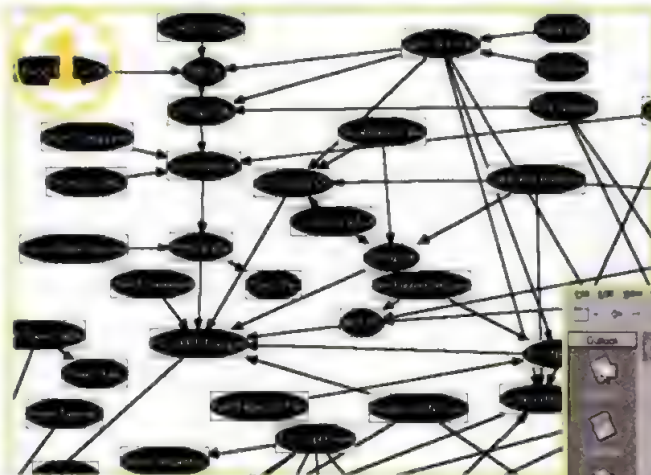
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Machines, Ray Kurzweil refers to Deep Blue as an idiot savant. Deep Blue was remarkably capable at chess but completely lacking in the ability to do anything else. In fact, the technology behind Deep Blue is not being applied to similar "thinking" applications. Rather, the incredible processing power that lets Deep Blue simulate millions of possible chess outcomes is being used to perform previously impossible tasks or ones that required the time-consuming creation of physical models.

Deep Blue developers foresee a time, for example, when a computer will aid doctors in analyzing a patient's condition and assist them in creating new drugs right in their offices. On another front, Volvo

lowed the series of actions by the user and inferred what the user is trying to do.

The examples above are relatively simple, but Bayesian Networks can get extremely sophisticated. Microsoft Research has posted to its site a noncommercial, freely downloadable tool for creating and evaluating Bayesian Networks. The program comes with several sample files, such as one that models a car's electrical system and another that shows the logic in the Windows 95 Print Troubleshooter. As with the technology shown by Deep Blue, such enhanced modeling of the decision-making process will allow software in the coming years to think with you and help you evaluate complex problems.



plans to cut the development time of new automobiles, in part by running such simulations as wind-tunnel tests on computer models rather than having to build physical prototypes. This is similar to the process Boeing used to design and test its 777 aircraft.

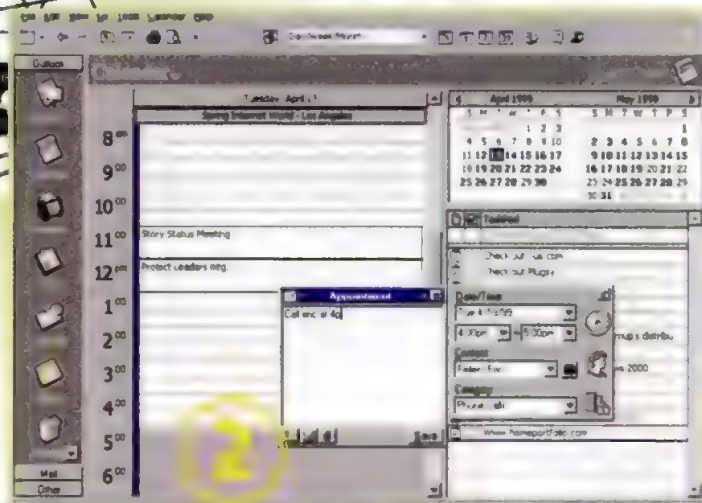
BAYESIAN NETWORKS

Few if any of the applications that most of us use do very much that could be interpreted as thought. There are, however, some signs that very simple thought is being introduced into mainstream products. Consider Microsoft Office. In Office 97, Microsoft introduced the Office Assistant. This little animated character watched what you were doing in your word processor or spreadsheet program and offered tips and answered questions to make it easier or to help you tap more of the program's power.

Much of the concept behind tools such as the Assistant comes out of Microsoft Research's Decision Theory and Adaptive Systems Group. The group has been studying Bayesian Networks, a system that creates an interconnected network of the probability of concurrence among various actions and conditions. So, for instance, when a user types a few words and then hits the Enter key twice in Microsoft Word, the Assistant suggests converting the paragraph to a heading. The program has fol-

TRULY THINKING

In 1950, computing pioneer Alan Turing proposed the imitation game, which would judge whether a computer had finally reached the level of human thinking. Often referred to as the Turing Test, the game lets you ask a question of both a human and a computer. The computer is



1.] The Decision Theory and Adaptive Systems Group within Microsoft Research studies Bayesian Networks. This one shows the logic in the Windows 95 Print Troubleshooter.

considered able to think if you cannot tell which answer came from the human. Turing stated that he believed that it would be possible "to program computers—to make them play the imitation game so well that an average interrogator will not have more than 70 percent chance of making the right identification after 5 minutes of questioning." Turing was overly optimistic in predicting that this would happen by 2000, but many technologists feel that we'll see such a computer in the next century. Kurzweil speculates that this will happen in 20 to 30 years.

It's a huge leap from the software you use today to programs that think and react in the same way we do. But clearly the gradual increase in software "intelligence" promises programs that will help you do more—whether it's finding the cure for cancer or simply getting that report out the door.

2.] Actioneer's smarter front end to Microsoft Outlook uses natural-language commands to organize your schedule.

The Internet Economy Will Take Over

•••• The economy of the future will be increasingly global, electronic, and Internet-based.

By Don Willmott

What is the Internet economy? It's Priceline.com, where you name your own price for airline tickets. It's eBay auctions, where close to 2 million items are up for bids. It's Amazon.com, where 8 million people have shopped for discounted books and music so far. It's the online brokerages that currently manage \$400

thing, it's good for managing databases and sharing information.

LOWER PRICES FOR ALL

Buyers and sellers have opened up lines of communication that are cutting out layers of middlemen and cutting down—or in the case of a company like Dell Computer, all but eliminating—costly inventories. The result: lower prices all around and more customization of the things you buy, whether those items are PCs or pajamas.

And that's the other, less obvious, impact of the Internet economy. The people who do the selling are finding that their world is turning inside out. Whether they sell in malls, through catalogs, or at discount warehouses, they all realize that selling and dealing with their chain of suppliers online are efficient, cost-cutting ways to get things done. Imagine how much money L.L. Bean will save when someday, perhaps not too long from now, the company stops printing and mailing catalogs.

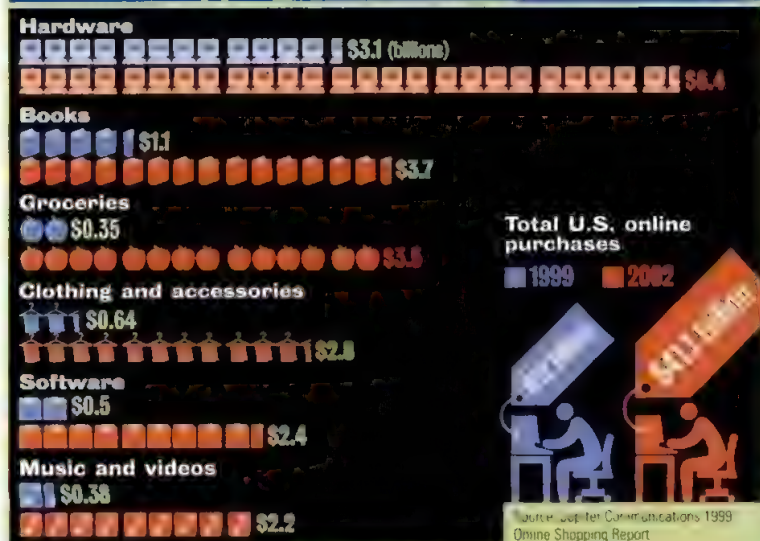
What's the role of good old paper money in the Internet economy? Are we headed for a cashless society? Some might argue we're already getting there. Many of us pay bills online automatically each month, and most online consumers are no longer afraid to type in their credit card numbers. Secure electronic transactions make credit card fraud very rare on the Web, and security will only get tighter as we move ahead.

Digital/Compaq, IBM, and Microsoft have tried to launch "digital wallet" initiatives. Digital wallets let you store money on the Web and use it in "micro-transactions" to read an article for 25 cents, download a song for 49 cents, or the like. So far, Compaq's MilliCent and Microsoft's Wallet have gotten more attention outside the U.S. than they have in it.

The smart card is another trend that hasn't quite taken off here. Storing cash on the Internet and deducting it onto smart cards to be used at places like coffee shops and newsstands may be popular in Europe, but not here—yet.

Who knows? Shoppers from around the world may end up showing Americans how it's done. Though U.S. consumers did 76 percent of the online shopping in 1998, that amount will decrease to 55 percent in 2002. The Internet economy may have been an American phenomenon so far, but the borderless nature of the Web guarantees that in the future it will be as big as the world itself.

Online Shopping in the Future



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billion in assets, and it's your online banking setup. It's groceries delivered via FedEx to your doorstep, and it's prescription drugs arriving in the mail. And it's just getting started. The 180 million Web-connected Americans who will spend \$41 billion online in 2002—up from \$7 billion last year—have much to look forward to.

The Internet is proving so successful at copying and then improving on the ways people shop and the ways businesses work that soon—sooner than any expert predicted—the Internet economy will be the single biggest part of the global economy's infrastructure. The novelty will wear off, and the online distinction will simply disappear.

The most important change is that you, the customer, will have access to much more information about goods and services than you ever imagined possible. Access to real-time information about prices leads to more efficient marketplaces, where the price you pay better reflects actual demand. Online auctions are, of course, the best example of that phenomenon. If the Internet is good for any-

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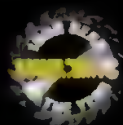
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You'll Look at Computers in a Whole New Way

..... Clunky desktop CRTS will be replaced with smaller, lighter, higher-resolution panels that you'll take with you wherever you go. *By Sebastian Rupley*

For years, you've been hearing about the paperless office, but to get there means you must feel as comfortable looking at a computer screen as you do ink on paper. To this end, new technologies are being developed to replace standard displays—cathode-ray tubes (CRTs) and liquid crystal displays (LCDs)—which are bulky and consume lots of power.



As a first step, researchers at IBM have developed new flat-panel technology that offers up to four times the resolution of Super XGA (1,280-by-1,024), the best traditional desktop LCD display available. Instead of the standard display materials (molybdenum and tungsten), researchers use aluminum and copper, which are better conductors and lead to higher resolution.

The result is Roentgen, a 16.3-inch display with a resolution of 2,560 by 2,048 pixels (over 5 million pixels with 200 dots per inch). Although it will initially be available only for medical imaging applications, once researchers figure out how to cut the display's power consumption, it'll be on your laptop.

At Xerox PARC, Nicholas Sheridan has been working on the ultrathin Gyricon display, which consists of millions of plastic balls enclosed in a pocket of oil within a sheet of rubber. Each ball has a white half and a black half and carries an electric charge. The black side creates black dots, and the white creates white dots, much the way a photograph is displayed in a newspaper.

Once in place, the balls lock to provide long-term storage of an image, or you can change the charge and create a new one. Researchers are aim-

ing for a resolution of from 400 to 600 dpi, which is laser printer quality (desktop displays are about 75 dpi). Sheridan hopes Gyricon will be a technology flexible enough to create electronic books, electronic newspapers, and even electronic wallpaper.

Xerox is also at work on DataGlyphs, a technology for printing machine-readable data on paper documents. DataGlyphs can encode text, data, or graphics onto plain paper which, when scanned into a computer, can do anything from simply bringing up a Web site to launching a program, printing specified documents, and then shutting the program down.

Larger displays are the first goal of E Ink (as in *electronic ink*) Corp., whose approach draws on research on electrophoretic processes by the MIT Media Lab. E Ink is an inklike material that can be used with standard printing processes but can change color under the influence of an electric field. E Ink hopes to start marketing changeable traffic warning signs, theater marquee displays, and in-store signs as early as next year.

Both E Ink and Gyricon may play a part in creating a new generation of electronic books. We've already seen the first round from such companies as NuvoMedia and SoftBook, but these machines, which often download material from the Web, use conventional LCDs. But the E Ink or Gyricon processes could allow for a different kind of electronic book, one that uses thinner, lighter, and more readable displays instead of a single LCD.

Taking the electronic book concept one step further is a project called Folio, currently underway at the Interaction Design Studio at Carnegie Mellon University's Institute for Complex Engineered Systems. Folio's goal is to make computers conform to humans, getting rid of the unnatural contortions we go through to interact with our machines.

Working for Intel and the Defense Advanced Research Projects Agency, the CMU researchers created a display made of eight hinged, full-color polymer LCD panels. Folio folds up to fit in your pocket. Unfold it once and it's a writing pad, twice and it's a book or Web browser. Unfold it completely and it's large enough to display maps or work as a PC screen.

As far as the foreseeable future, paper documents are here to stay. But for lots of information or data that change frequently, one of these new technologies—whether LCDs, Xerox's Gyricon, MIT's E Ink, or something else—may hold an answer.



Roentgen, the next-generation display from IBM, boasts up to four times the resolution of Super XGA. This 16.3-inch flat-panel display has a 2,560-by-2,048 resolution.



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Entertainment Will Be Virtual

Digital characters are becoming more lifelike, pulling you inside the games, movies, and chat rooms that used to be strictly two-dimensional.

As digital characters in 3-D games and on-line chat rooms are beginning to look and act more human, "live" actors in movies are becoming increasingly digital in origin. Throw in automated response bots that can simulate human conversation or take human form, and you see that in the future it will be difficult to tell whether the character you're watching on-screen or chatting with on the Internet is virtual or real. We can tell you that the Internet will become an increasingly larger source of video entertainment content enjoyed in the home, and that producing high-quality digital video will soon be both technically accessible and affordable.

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To get a taste of how online chat is rapidly evolving and enveloping multiple data streams, be sure to stop by ZDTV's chats, powered by Electric Communities' The Palace. There you'll see how the latest chat technology can combine avatars, streaming chats, and even ZDTV Net cam feeds to create a virtual studio audience to accompany ZDTV's many shows. www.zdtv.com



DIGITAL CHARACTERS GET REAL

You don't have to be an adolescent male to recognize that animated characters—such as Tomb Raider's shapely Lara Croft—can develop quite the cult following. This trend should only increase as characters continue to look and act more real.

Contributing to this advancing visual realism are relentless improvements in the 3-D hardware capabilities of the base gaming platform. When Intel shipped the Pentium III this year, the chip had a new instruction set named Streaming SIMD Extensions (SSE), dedicated primarily to speeding 3-D geometry calculations in applications that use the extensions.

In truth, many SSE instructions match those in AMD's 3DNow! instruction set, but Intel's broader reach should translate to greater developer support for the new instruction set. In fact, we expect many future graphics chips to perform geometry and lighting calculations on-chip. With geometry processing catching up with rendering, game developers can produce more finely detailed characters without the jaggies or blockiness evident in many 3-D games.

New technologies like The Motion Factory's Motivate 3D Game Development engine should enable a broader, richer set of interactive behaviors that work well in low bandwidth environments like the Internet. Building on technology borrowed from robotics and real-time process control, Motivate 3D builds digital actors that have skills and behaviors, enabling a varied set of reactions to user input and the ability to render on the fly. These advancements in 3-D processing and game-development tools should result in characters that are more realistic in appearance and also more intelligent.

As digital characters are becoming more lifelike,



digital representations of actors are playing an increasingly larger role in Hollywood films. These digital actors participate in stunt scenes too dangerous for real actors, star in digitally created sets and let producers make the characters appear older or younger, thinner or fatter—without all that expensive plastic surgery.

The first step in creating a digital character is to scan minute cross sections of the character's body, head, and face, including many different facial expressions. Then map the scanned images onto digitally created body parts and animate movements and facial expressions for the individual scenes. The process takes up to six months and costs as much as \$300,000 today; not cheap, but a drop in the bucket compared with the multimillion dollar salaries of some Hollywood stars. Use of these digital characters should only increase as producers attempt to push the envelope on both special effects and stunts.

It's easy to dismiss the Internet as a serious distribution medium for digital films and video, but twin forces similar to those driving the MP3 digital

Illustration by
William Duke



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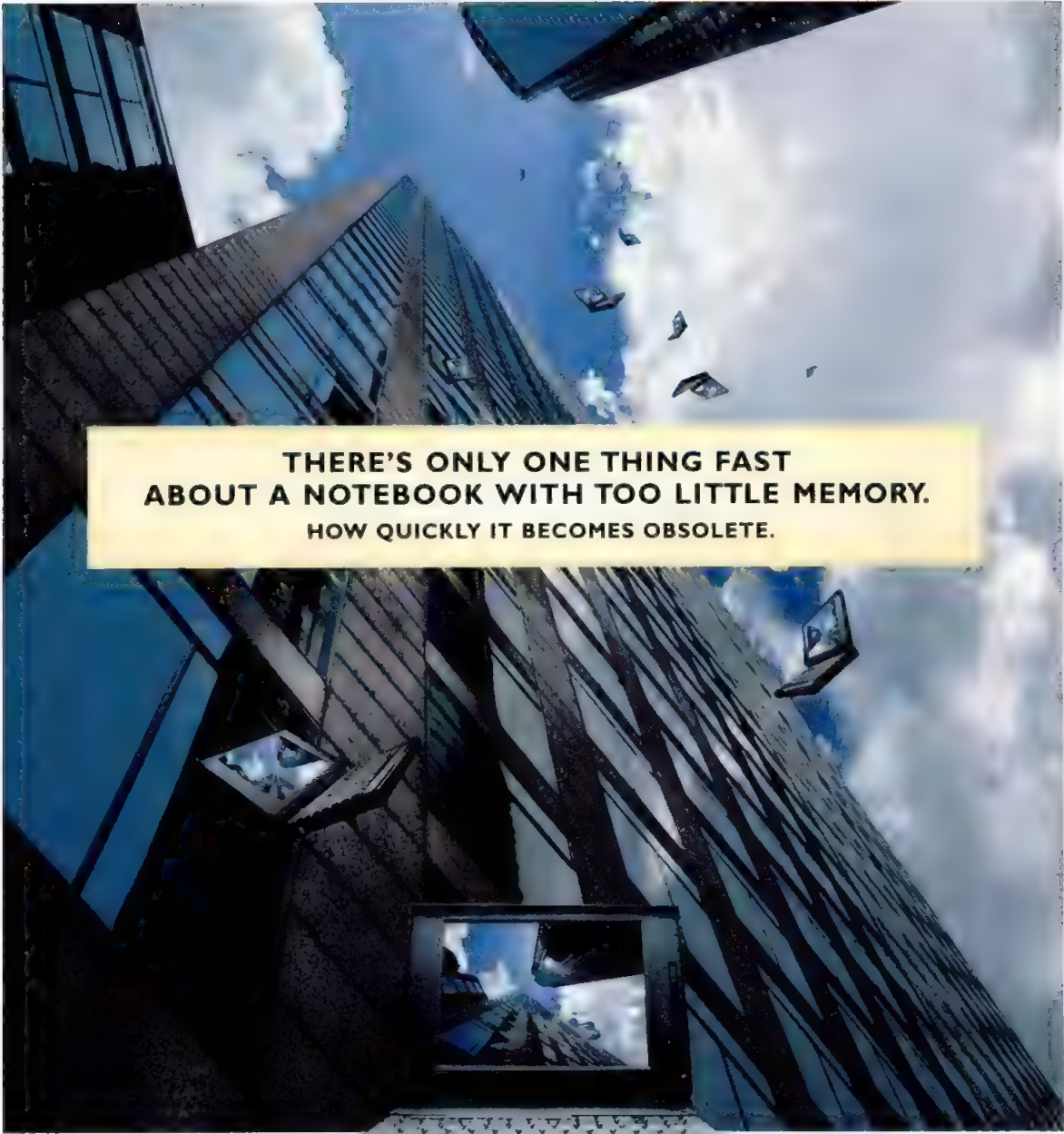
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audio format are fueling this trend. Artists whose films wouldn't otherwise see the light of day are pushing the Internet as a distribution medium. AtomFilms for example, distributes digital versions of short feature films typically not shown in theaters or sold through video stores, including this year's Oscar-nominated shorts.

Pulling demand from the viewer's perspective is the Internet as a storage mechanism for an extraordinarily broad selection of old films, television programs, and other video content. At broadcast.com, for example, you can relive the joys of Bob Hope's Christmas shows or hundreds of other similarly obscure videos unavailable elsewhere.

At the same time, the costs of producing MPEG-2 (the encoding technology used in Digital TV and DVD video) is dropping dramatically. For example, ATI is shipping several graphics cards that can pro-

Words avatars are 3-D objects you move through 3-D space—up, down, all around. They can jump, wave, dance, and stomp their feet in anger. Stand quietly for a moment and your avatar will shift its feet nervously, check its watch, glance around, or scratch its head.

No discussion about virtual entertainment would be complete without addressing hardware peripherals such as stereoscopic 3-D glasses and "force-feedback" joysticks, which simulate actions such as shooting missiles, taking 8-G turns, and the occasional, unavoidable crash.

The stereoscopic headset market has two very different levels. At the low end (around \$100) are passive VR glasses, which improve the 3-D visualization but have no impact on the game. At the high end, costing several thousand dollars or more, are glasses that monitor head movements and input them into the game itself, so you can peek around corners or look around you and the game will respond with appropriate views.

As we learned with 3-D graphics (and many, many previous technologies), new hardware peripherals typically don't achieve significant game support until integrated into DirectX, Microsoft's standard for interfacing games and other applications with a range of supporting hardware. DirectX 5.0, which shipped

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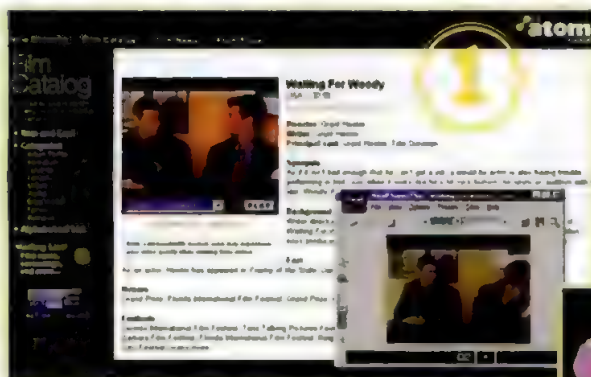
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duce MPEG-2 video in real time, but they require a Pentium III-based PC. Later this year will see the introduction of real-time, IEEE 1394 (FireWire)-enabled MPEG-2 encoding cards costing well under \$500 and dropping to the \$200 to \$300 price range by the year 2000. MPEG-2 is the first "no apologies" video that looks as good as broadcast video (because it is broadcast video, serving as the video compression technology for today's satellite-based video delivery systems), Digital TV, and DVD.

CHAT: BEYOND TEXT

Online chat may have started as a text-driven experience, where your moniker was your most distinguishing characteristic and emotions were expressed in emoticons and acronyms such as LOL. But today you chat in 2-D and 3-D worlds, decorated in accordance with a theme, approaching other participants by walking up to them and typing "hello." You choose an avatar, which you can create in your own image or any other you want to project. Anonymity is still king, and you can be who you want to be.

In 2-D worlds like The Palace, avatars are bitmaps that you can shift around the screen with your mouse. Motion is fast and simple, leaving chat the primary focus. In 3-D spaces like Worlds Inc. and Active



Words in 1997, included a new specification for joystick force feedback, easing the task of integrating these effects into games and helping to ensure field compatibility between game and joystick. But Microsoft has not yet integrated stereoscopic headset support into DirectX. This means that the current crop of stereoscopic 3-D glasses ship with a few drivers for specific games or use generic drivers with proprietary techniques that search game output for "depth cues," which are converted into 3-D effects. Microsoft does intend to support stereo vision glasses in DirectX 8.0, which means that standards will appear sometime in the year 2000.

Virtual entertainment will never replace the human interaction found at work or school, or other places where people go to see and be seen. But as your movie choices grow exponentially, as games become more lifelike, as online chat becomes more realistic and more fantastic, pulling yourself away from your PC will be tougher and tougher.

- 1.] As bandwidth increases, more and more entertainment will be available over the Web. AtomFilms delivers short films that don't show at the local multiplex.
- 2.] Create 3-D avatars in Active Words that may or may not be in your own image.



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Your Identity Will Be Digital

♦♦♦♦ As the world becomes more and more digital, so do we, challenging us to restrict and control our personal information in cyberspace. *By Jake Kirchner*

Regardless of whether you like it or even know it, you have already established a digital identity. That identity is a constantly growing and shifting amalgam of your personal information, stored in the databases of state and municipal offices, hospitals and medical centers, insurance companies, stores, banks, and more federal agencies than we can imagine. That shifting, inchoate digital identity is destined to become much more "real." It will be sharply defined because you will construct and control your own digi-

modern conveniences. Privacy is no longer about voluntary anonymity. Privacy in the digital age means the ability, through legal and technical means, to control information about ourselves. Equally important will be the widespread social acceptance—even the expectation—of individuals having access to those controls and using them on a regular basis.

This trend toward more individual control will continue because the stakes, already large, are growing rapidly. Every year there is much more to control than the relatively few digital records that marked the mainframe era of personal record keeping. Beyond that, additional types of personal data are increasingly being gathered for use in biometric security systems, meant to verify your identity for work or commerce or to allow access to buildings or computers. Throw in digital brain scans, electrocardiograms, and MRIs, and it's clear that no part of our persons, thoughts, actions, or histories is digitally off limits.

You should not be surprised, then, to realize that securing your rights and abilities to control the gathering and use of these kinds of digital data will become a greater part of the national, political, and social debate. There is a growing acceptance by Web-based businesses that they have to post detailed privacy policies on their sites. More and more of those policies are verified by TrustE, an independent, non-profit consortium that promotes principals of disclosure and informed consent. TrustE licensees agree to disclose information and privacy practices that must include the kinds of information the site gathers, how that information is used, and with whom it is shared.

Look for continued cooperation and joint projects by a wide range of public policy groups, industry lobbyists, and high-tech coalitions that likely will work together more closely in the coming years to develop consensus approaches to these technological issues.

On the legal front, look for the Federal Trade Commission to follow through on its threat to issue Internet security and privacy regulations if voluntary actions don't bear fruit soon. And members of Congress, already stung by the Internet community's rejection of censorship laws, won't need much prodding to turn their legislative attention to the privacy concerns of their constituents.

It shouldn't be surprising that many in the digital community are looking to technological solutions to what is essentially a technological problem. For decades, encryption has been a major vehicle to help ensure digital privacy and security issues. And a vari-



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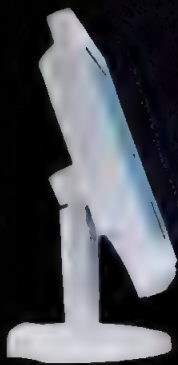
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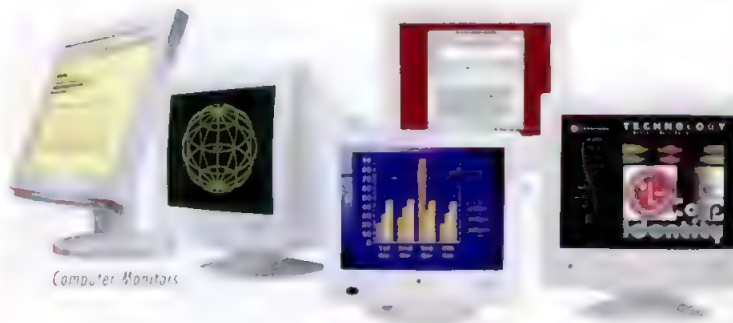
As we head into the new millennium, privacy is no longer, in the famous words of Justice Louis Brandeis, the right of every American "to be let alone." It isn't even the ability to withhold personal information. How many would forego a home mortgage rather than fill out a loan application? How many would refuse medical treatment rather than divulge their Social Security numbers to insurance providers?

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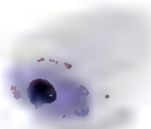
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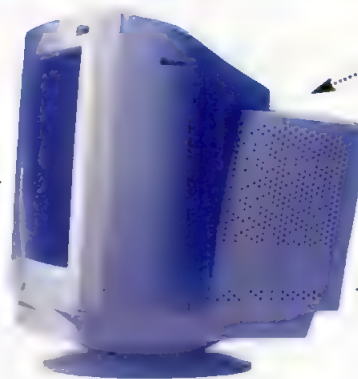
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images.



10% shorter in depth
than the conventional
19" monitor provides
you more space for
computing environment.

USB

Integrated USB* Powered
Hub allows easy connection
with your USB peripherals
such as keyboards, printers,
scanners, mice, joysticks
and speakers ...etc. (up to
127 devices total.)

THE SHORT-LENGTH VALUE SERIES

Model	Screen Size	Viewable	Short Tube	Max. Resolution	Dot Pitch	USB* Powered Hub
VL700S/SL**	17"	15.9"	YES	1280x1024	0.27mm	YES
VL710S/SL**	17"	15.9"	YES	1600x1200	0.25mm	YES
VL950S/SL**	19"	18"	YES	1600x1200	0.25mm	YES

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ety of encryption approaches, particularly some involving public key systems, have been built into many of the computing and Internet schemes to protect digital data. Encryption will continue to become more effective, transparent, and generally user-friendly in e-mail, browser, and e-commerce programs in the coming years. The trend is more likely to favor server-based encryption over approaches that require end-user intervention.

We don't mean to imply that end users are unwilling or unable to apply technical solutions on their own. The newest versions of Microsoft Internet Explorer and Netscape Navigator have extensive features for setting user profiles, managing cookies, filtering content, making use of secure digital signatures and certificates, handling encryption chores, and in general limiting the amount of information you automatically reveal about yourself on the Web.

FEELING SECURE

The unexpected strong reaction to the Pentium III's unique serial number emphasizes to the entire PC industry the growing intensity of the digital identity debate. On the plus side, privacy advocates hope the controversy will further development of systemwide security architectures and approaches.

One such developmental effort is the World Wide Web Consortium's Platform for Privacy Preferences (P3P), which combines electronic forms, agents, and user-customizable security levels to automate a user's interaction with Web sites through P3P-compliant browsers, plug-ins, or servers. Also, Intel has developed the Common Data Security Architecture (CDSA), a set of APIs designed to make computer platforms more secure, particularly for applications such as electronic commerce, communications, and content delivery.

The growing use of smart cards, especially outside the U.S., paves the way for their acceptance as standard security devices. A smart card, whether in conjunction with passwords or biometric data, can help protect your digital identity by letting you carry that identity embedded in the chip on your own card, rather than have to store the identifying information in databases scattered across or linked via the Internet. In the future, those chips will be embedded in our clothes and perhaps eventually in our bodies.

Look also to for-profit organizations to try to take advantage of the growing perception that Internet development is being held back by a sort of consumer paranoia about privacy and security. Third-party verification service providers and vendors of shrink-wrapped client and server products will proliferate.

For example, the public key encryption-based digital certificates that now have limited use in browsers will become commonplace. They will be usable by any program and be a feature of future smart card identi-

ty systems. More important, there will be a growing number of third-party certificate authorities—governmental agencies, communications services providers, and for-profit services vendors—acting as middlemen to vouch for your digital identity in e-commerce and other applications without requiring you to divulge personal information.

Novell recently announced digitalme, a software architecture to let consumers create and manage their digital identities for Internet commerce. This technology is particularly interesting because it attempts to implement the approach increasingly promoted by privacy advocates—personal control of your own identifying data. You'll be able to determine exactly which personal data you share with or sell to any Web site you visit. You could even establish multiple personal identities for different activities—say, one that's specific and verifiable for e-commerce and another that's more anonymous for Web chat.

These individual efforts in the areas of technology, public policy, and consumer protection will lead step by step to a set of technical and regulatory frameworks that can be adopted universally in everyday computing.



HOT LINKS



www.pcmag.com/hotlinks

► **Electronic Frontier Foundation**
www EFF.org

► **Electronic Privacy Information Center**
www.epic.org

► **Online Privacy Alliance**
www.privacyalliance.org

► **The Center for Democracy and Technology**
www.cdt.org

► **TrustE**
www.truste.org

The Digital You

Biometrics can measure unique individual characteristics well beyond fingerprints.

1.] Individual attributes of your face are measured by themselves

and in relationship to one another, creating a complex digitized mathematical model.

2.] Every person's iris and retinal patterns are unique and can be scanned like a human barcode.

3.] A spoken word can be matched over the phone against a digitally recorded voiceprint for remote database access.

4.] The geometry of your hand, pattern of veins in your wrist, and the map of your pores can be used as unique digital identifiers.

5.] Even identical twins have unique fingerprints, but the patterns created by their knuckle creases are also one of a kind.

Moore's Law Will Continue to Drive Computing

..... Computing power has increased at an amazing—and amazingly consistent—pace. New technologies promise more of the same in the future. **By Nick Stam**

In 1965, Intel Corp. cofounder Gordon Moore predicted that the density of transistors in an integrated circuit would double every year. His observation, dubbed Moore's Law, was later changed to every 18 months. Moore's Law has proven remarkably accurate for over three decades. Not only transistor density but also microprocessor performance tends to follow Moore's Law.

Andy Grove, former Intel CEO and chairman, predicted at Fall Comdex 1996 that by the year 2011, Intel will ship a microprocessor with 1 billion transistors, operating at 10 GHz, using a 0.07-micron semiconductor process technology able to calculate 100 billion operations per second.

Microprocessor Report's founder and executive editor, Michael Slater, thinks that in the future, doubling transistor count may require more than 18 months when moving from one major chip design or fabrication technology to the next. This is due both to chip logic's becoming more complicated (requiring longer design and validation time frames) and to increasingly difficult hurdles in chip fabrication technology.

FABRICATION IMPROVEMENTS

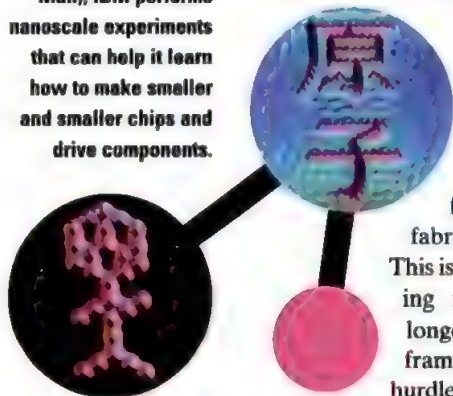
Fabrication technology must improve in many areas with each successive process generation, such as the move from 0.25-micron design to 0.18. One particularly critical process is photolithography, where short-wavelength light sources are focused with a number of precision lenses and shone through small transparent masks containing circuit details. This exposes the photoresist on a wafer's surface, which is chemically removed leaving microscopic details of the circuit pattern on the wafer.

According to Mark Bohr, who is Intel's director of process architecture and integration technology and an Intel Fellow, light sources and optics must evolve in concert. Later this year, Intel will ship 0.18-micron Pentium III chips using the same 248-nm wavelength deep-UV light source as used in current 0.25-micron Pentium II and Pentium III chips. But when moving to 0.13-micron processes three or four years from now, expect to see 193-nm wavelengths using excimer lasers as the light source.

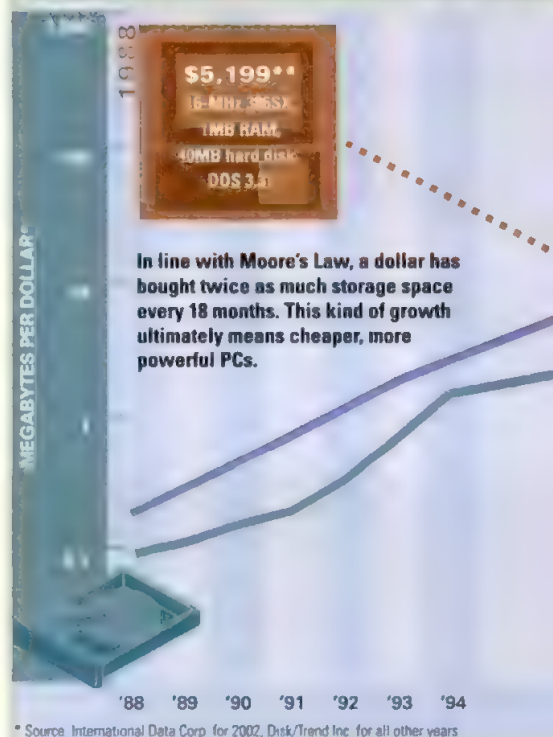
Beyond 0.13- could be a 0.09-micron process,

which would use 157-nm wavelength excimer lasers, according to Bohr. And the next step below 0.09 is a big one in terms of technology and manufacturing processes: the 0.07-micron process in Grove's processor of 2011. This level of photolithography will likely require extreme-UV (EUV) light sources. EUV has a wavelength of only 13nm, which has long-term potential for etching far smaller transistors but is con-

By arranging individual atoms into designs (top: Atom; bottom: Carbon Monoxide Man), IBM performs nanoscale experiments that can help it learn how to make smaller and smaller chips and drive components.



Moore's Law Affects More than



founded by the fact that there are no known transparent mask materials that will allow such short wavelengths to pass through. This requires entirely new reflective lithography processes and optics to be implemented coincident with EUV.

As you continue to increase the number of transistors over time, transistor interconnect wires get smaller and closer together, increasing resistance and capacitance while adding to circuit delays. To reduce resistance and shrink interconnect line widths at the smaller dimensions, copper will displace aluminum as the interconnect metal of choice, as seen in the new IBM PowerPC G3 chips. AMD's CTO, Atiq Raza, predicts AMD's new chips will be in copper by the second quarter of 1999. Bohr expects that future Intel



www.pcmag.com

For a more in-depth discussion of the future of processor technology, check out the full version of this story online.

CPUs in the 0.13-micron process and beyond will use copper interconnects.

PHYSICAL LIMITS

Power and heat management could pose huge problems in the future. As transistors continue to shrink, their gate oxides become only a few molecules thick in order to maintain required transistor switching speeds, and low voltages will be necessary to maintain their structural integrity. Intel has stated that chips ten years from now will operate at less than 1 volt and could easily consume 40 to 50 watts of power, which implies 50-amp currents or larger. Evenly distributing such huge amounts of current within the chip and dissipating the tremendous amount of heat generated

designs, instruction sets, register sets, external interfaces, and on-board memory sizes. According to John Hennessy, dean of Stanford University's School of Engineering and cofounder of MIPS Computer Systems, we are in the later stages of the quest for more instruction-level parallelism (ILP), particularly with the x86 instruction set, though we still do expect to see more complex 32-bit x86 processors from AMD, Cyrix, Intel, and others in the coming years.

There are plenty of creative microarchitectural techniques available to enhance 32-bit x86 designs for many years to come, according to Fred Pollack, director of Intel's Microcomputer Research Lab and an Intel Fellow. But Pollack also stated that reaching substantially higher levels of performance require totally new methods.

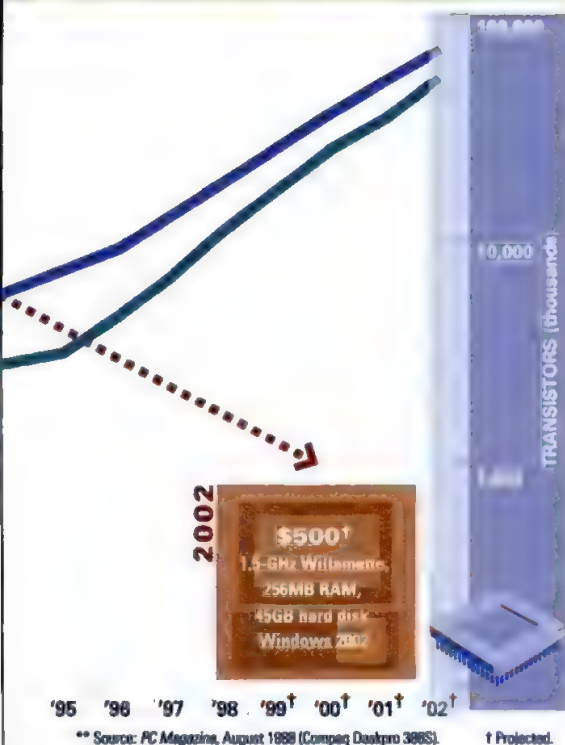
To move to the next generation, Intel and HP introduced their EPIC (Explicitly Parallel Instruction Computing) instruction set technology, which is a radical departure from x86, in October 1997. Their 64-bit IA-64 architecture is the first instruction set to incorporate EPIC principles, and their upcoming Merced processor is the first IA-64 implementation. Pollack says Intel will initially target IA-64 at workstation and server segments and future high-end 32-bit x86 chips at professionals and power users. Raza and Pollack think 64-bit processing will be mainstream in ten years, but they are hesitant to forecast 64-bit processors on all our desktops in five years.

An incredibly important objective, according to AMD's Raza is to get as much fast memory as close to the processor as possible and to reduce latencies to I/O devices. Raza claims we must design future CPU chips with far faster and more direct interactions with main memory, graphics, and especially lower bandwidth streaming devices. We'll also see a trend toward PC-on-a-chip designs.

Chip Multiprocessors (CMPs) include multiple processor cores on a single chip and are expected to proliferate during the next decade. We'll need to see more multithreaded applications and multitasking to take advantage of these architectures. In the long term, such multiprocessing designs may delay the need to shift to exotic computer designs, if we assume silicon technology really will hit the wall around 2017. But it will take time for CMPs and complex multithreaded applications to evolve in the mainstream markets, according to Hennessy. He believes the embedded-CPU market would be the first target for CMPs. Slater believes we'll see CMPs in workstations and servers, though memory bandwidth for the multiple cores on a chip could be a problem.

Expect much innovation for many years ahead in silicon fabrication and CPU architectures. You'll have a billion transistors on a chip by the year 2011—if not sooner—and your computing devices will be far more powerful than you can imagine.

Processor Performance



are both subjects of much research.

Will current silicon fabrication methods hit physical limits by the year 2017 (as many have predicted), meaning that we'll reach a point where we just won't be able to build usable transistors any smaller? It's difficult to look that far ahead, but research into areas such as molecular nanotechnology, optical or photonic computing, quantum computing, DNA computing, chaotic computing, and other seemingly esoteric areas of research may prove to be fruitful, changing totally the way we design and manufacture microprocessors or perform computations.

Not only will fabrication technologies undergo huge changes in the coming years, but so will microprocessor architectures, including in their logic

Milestones On Intel's Road Map

With every new Intel code name comes a jump in processor technology.

2011

- **Andy Grove's Chip**
10 GHz, 1 billion transistors; can calculate 100 billion operations per second

2002–03

Moves to 0.13-micron process that will include copper technology

2002

- **Madison**
Third-generation IA-64
- **Deerfield**
Price/performance IA-64

2001

- **McKinley**
Second-generation IA-64
Doubles the speed of Merced (over 1 GHz)

Mid-2000

- **Merced**
The first processor based on the IA-64 architecture

2000–01

- **Willamette**
1 Gihertz and beyond

1st half of 2000

- **Pentium III/700**
- **Celeron/500+**

2nd half of 1999

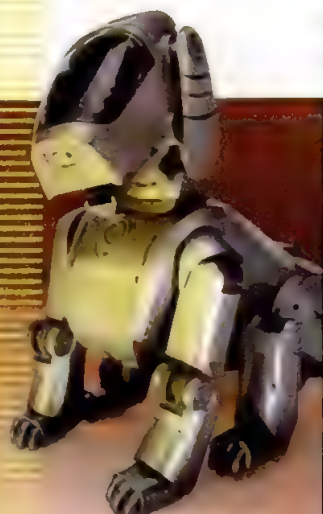
- **Pentium III/667 (Coppermine)**
Moves from 0.25-micron to 0.18-micron process
Bus goes from 100 to 133 MHz

Now

- **Pentium II**
Ends at 450 MHz

Also on the Horizon

Over the past few pages, we've given you a look at what we think are the ten major trends that are shaping technology today. But of course there are many other interesting ideas in the works. And during our debates from which the list was created, quite a few other trends were mentioned that also deserve some attention, five of which are described below.



Sony's robotic dog, the Sony ERS-100, can perform such puppy tricks as chasing a ball or shaking hands.

1

ROBOTICS COME HOME

Robotics are advancing at an amazing pace, but today most robots are at work in large companies, doing everything from sorting and delivering mail to helping to manufacture products from cars to laptops. But robots will begin to come home as well. Someday you'll have a simple robot to help with everyday tasks—perhaps one that will take out the garbage when it's cold outside.

2

YOU'LL BE THERE (VIRTUALLY)

New technology will let anyone, anywhere, participate in conversations, take part in classes, engage in discussions, see live video, and more. Some of this exists today—in chat rooms and with limited video conferencing—but better virtual reality software, digital characters, and faster bandwidth may make virtual conferences much more like the real thing. For example, you'll be able to have chats with virtual characters that look like your real-life teachers and classmates. There will be live video on every desktop, and you'll be able to connect anywhere. This will have a major impact on everything from training and education to travel, changing the way we live and work.

3

YOU MAY WEAR YOUR COMPUTER (OR IT MAY WEAR YOU)

Instead of pulling out a computer every time you need one, why not just wear one? That's what scientists at places such as IBM and Sony are thinking. The first incarnation may be a device you wear like a hat, or it may be eyeglasses that can display a transparent image. Connect this with a GPS system and it can tell you where you are. Connect it with the right database and it might show you prices at the nearest market. Take this a step farther to a world where computers become part of prosthetics, with electronic limbs or perhaps eyes and ears helping the disabled. Taken to the furthest extreme, it could mean a world where people have processors embedded in their brains, like the chip described by Peter Cochrane of British Telecom that would be implanted in your brain to control your PC.



IBM's wearable PC uses voice recognition to open and navigate applications, and the headset is actually a micro-display.

4

GRAPHICAL USER INTERFACES GET COMPETITION

In many ways, the Windows or Macintosh user interface we're all used to hasn't changed much since Xerox PARC first developed what we recognize as the GUI. Although we may be used to working with them, GUIs are hard to navigate without a mouse. And as computing less often means a keyboard and monitor, different interfaces must be developed. Voice recognition, for instance, will be more common in places such as automobiles or for some consumer devices. And both voice recognition and synthesis will be used more often on phone-based systems.

5

COMPUTING IS DISTRIBUTED

Forget the idea of a personal computer that contains all your information. Forget the central mainframe computer or server with all the data and all the processing power. Forget even the idea of client/server computing. Tomorrow's computing will be distributed, with lots of computers of all kinds working together to share information, perform amazing calculations, and track all kinds of data. That doesn't mean the personal computer will disappear—instead it will link you to lots of other computers for tasks like sharing data, doing sophisticated calculations, and running personal agents.

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LOW PROBLEM
RATES."

P.C. Reliability &
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PC World
November 1998



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* *PC Reliability & Service Survey, PC World, Nov. 1998*

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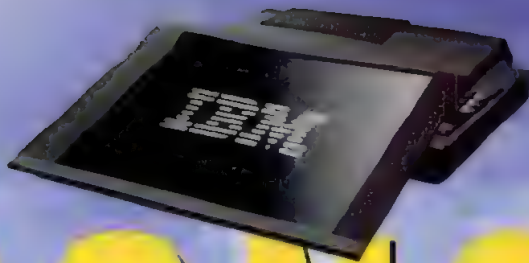
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CONCEPT COMPUTERS

>>>By Cade Metz



When discussing the future of computers, today's PC pundit is apt to drag out a trite reference to "Star Trek," *2001: A Space Odyssey*, or, more playfully, "The Jetsons." Yet we know the PC won't fulfill the speculations of sci-fi pop culture for many years to come. Nor is it intended to. Today's PC is meant to make our lives easier, more productive, and generally more enjoyable, although it achieves those goals only fitfully. In the near future we can expect enough progress that we'll see systems that—unlike the common off-white mini-tower—are convenient, tractable, in tune with our everyday environments, and even attractive. Many of the industry's leading companies and research labs have been developing such machines, which we like to call "concept computers" because they embody new ideas in design and ease of use. They're not science fiction, and some are only months away.

>>>Illustration by John Craig



→ OPEN

Inside: Photograph of jacket by
Webb Chappell © 1997

IBM PC Watch

"With silicon in a very thin package," says IBM's Phil Hester, "we can think about building a wristwatch whose face is an active display." Such is the basis for an IBM project tentatively known as Watch Pad, which seeks to put a great deal more digital information around our wrists than ever before. Equipped with a display offering adjustable fonts and font sizes, this personal information manager for the aspiring Dick Tracy will allow you to scroll through data with the tip of your finger and wirelessly transmit that data to remote devices. "You'll use it as digital phone directory," continues Hester, "a business card database, or a calendar."



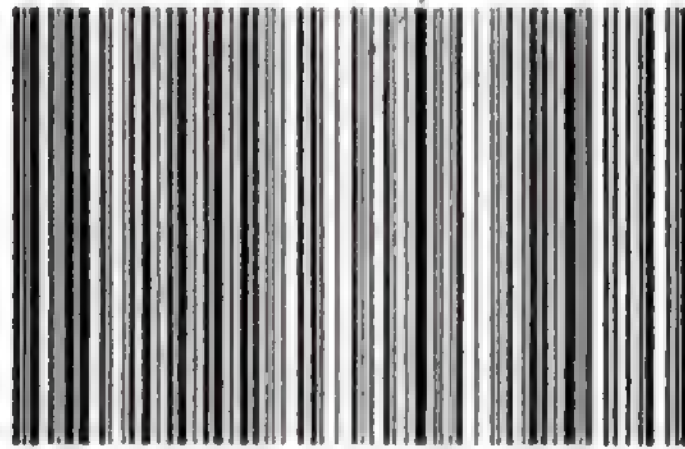
Mr. Java

of the MIT Media Lab's Counter Intelligence Group (a pun on kitchen Mr. Java machine is a coffeemaker crossed with a PC—an appliance able to learn and adapt to your tastes. It reads information from a memory chip on your coffee cup, then it dispenses your favorite coffee and, while you're waiting, plays your favorite Internet radio station. "We have one researcher here," says MIT's Jeff Seidman. "When he gets coffee, he hears Athens in the future, speculates Seidman, whole rooms will operate like Mr. Java, reacting on the fly to the person walking through the doorway.

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Back

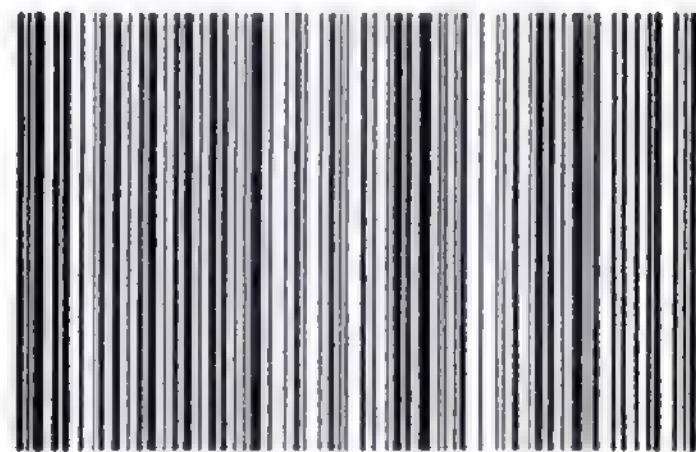
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Inverted Back

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GbsSlipSheet-001

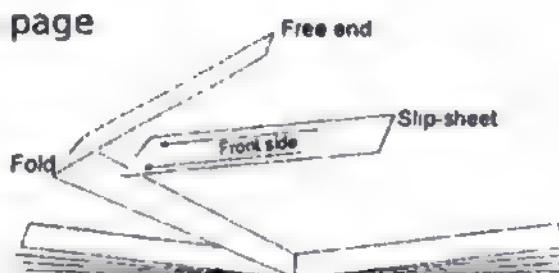
Inverted Foldout slip-sheet

Foldout slip-sheet



1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

1. Open the foldout page
2. Insert this sheet with
 1. Front side touching the free page
 2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet





MIT Wearables

Researchers at the MIT Media Lab are famed for their work with wearables—PCs that you put on. Using electrically conductive thread, they've stitched working keyboards and touch pads into typical, commercially available jackets, letting you record information on your person or—via a wireless connection—send it on to a nearby desktop PC. "Anything you can sew this thread into," says MIT's Jeff Seideman, "is a potential machine." Along similar lines, the lab has developed clothing that monitors your health and shoes that exchange data with the shoes of the person walking toward you. In the future, you may never need to leave your PC.



MIT M

An outgrowth (counters), the M to recognize you the base of you waiting, who's Gr radio." In Java, ada

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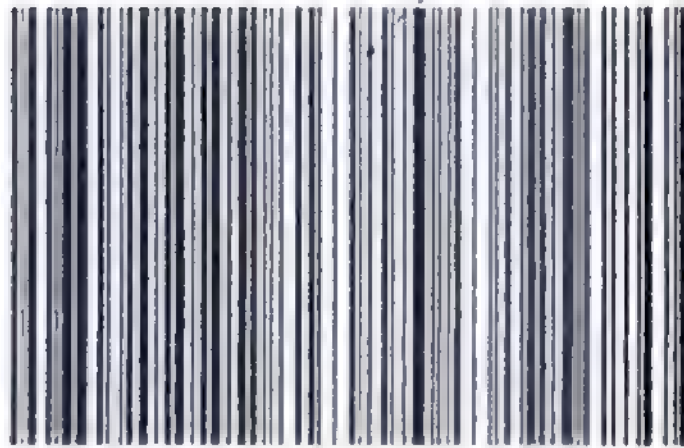
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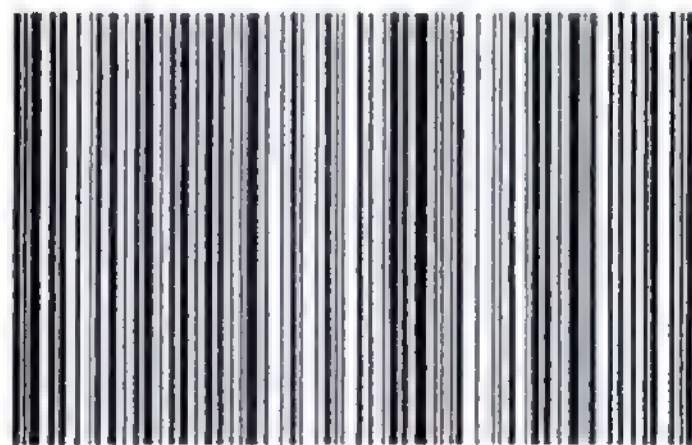
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Inverted Back

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Inverted Foldout slip-sheet

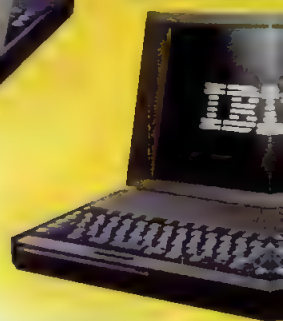
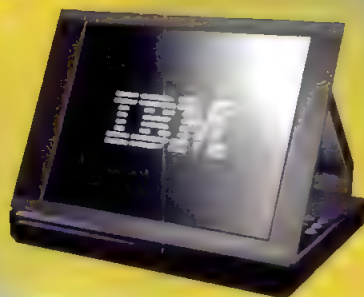
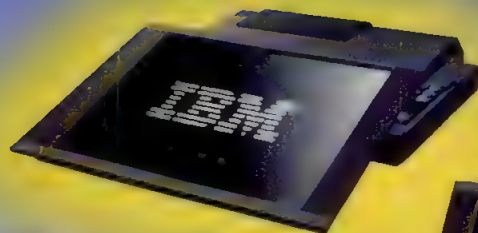
Foldout slip-sheet



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2. Insert this sheet with
 1. Front side touching the free page
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3. Slice the folded edge
4. Close the page and slip-sheet

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Chameleon proto-
book, offering a l
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becomes a televi

Intel Aztec

"Many people won't buy a PC that looks like a PC," says Intel's Frank Soqui. The classic beige and rectangular computer, after all, is associated with erratic behavior, complication, and failure. With its Aztec prototype—built in anticipation of the near future, when PCs will be both easier to use and more attractive—Intel is ditching antiquated hardware that makes today's machines so complicated, boiling things down to a charming, hat-size pyramid. "The only way to connect external devices only through USB, FireWire, and VGA ports. "The VCR," continues Soqui; "it's simple, and there's no need to





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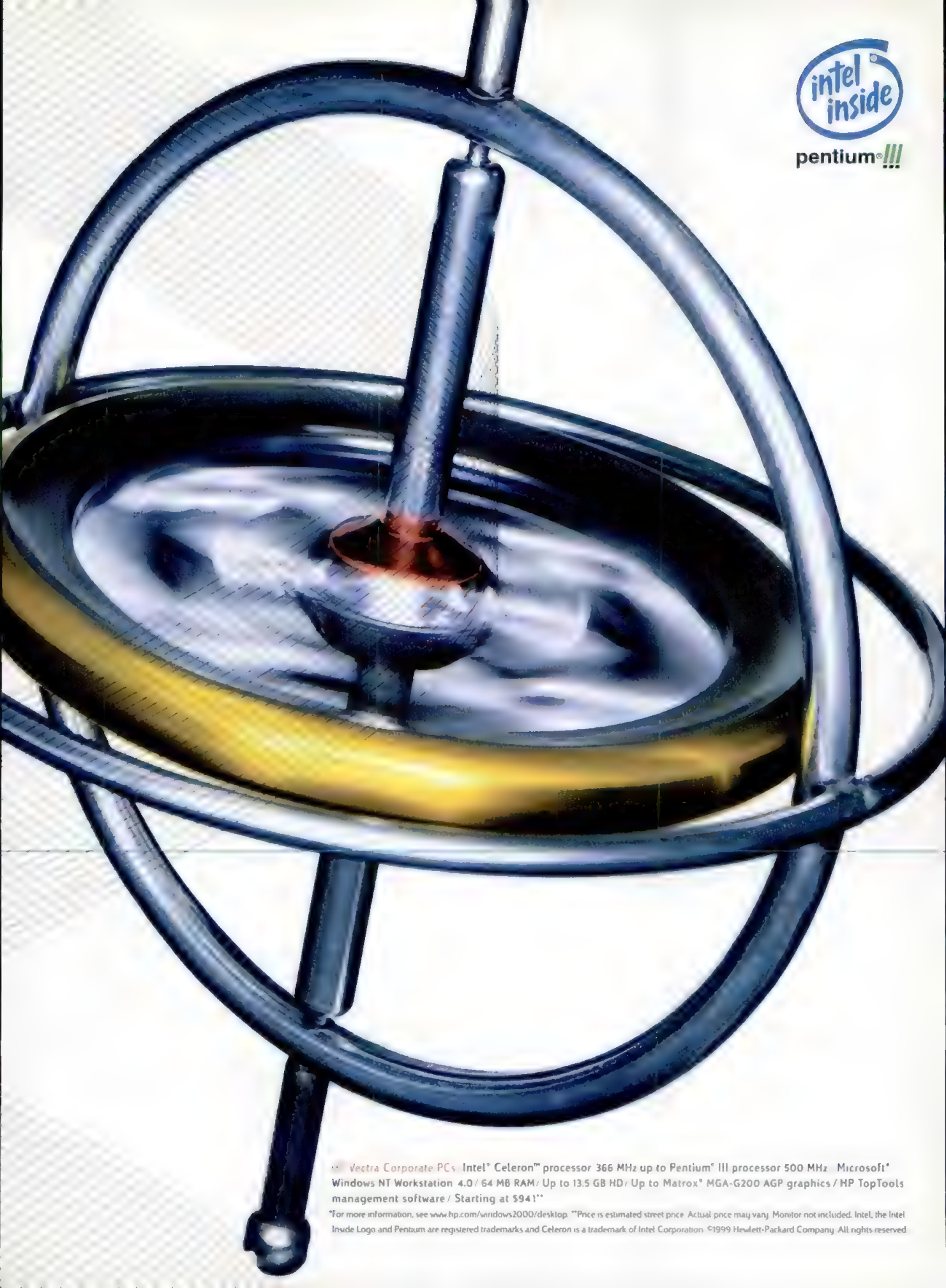
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Managed

If you think there isn't much to differentiate a corporate PC from a run-of-the-mill PC save for an Ethernet card, a service contract, and a hefty markup, think again. Competition in the PC marketplace is fierce, and major manufacturers realized years ago that in order to win over corporate buyers they needed to offer those customers more than a beige box with the latest components. Enter managed PCs: systems that are readily attached to a network, readily managed over that network, and readily serviced with a minimum of IT time.

The managed PC has made several notable strides of late. For instance, systems from the leading players are now generally easy to upgrade and repair, offering cases that open like lunch boxes and drives that slide out like dresser drawers. Though accompanying software designed to query and monitor these machines over a network is often diffuse and rarely comprehensive, it too is improving and could soon make remote PC management as simple as it's meant to be.

A managed PC is defined by how easily it can be purchased, set up, monitored, upgraded, repaired, and (perhaps) purchased again. So to be included in this roundup, a machine had to comply with the Desktop Management Interface (DMI) 2.0 specification and ship with some form of remote-management software. Since evaluating manageability and serviceability as well as pre- and post-purchase support was our goal, we leveled the playing field by asking that each machine come equipped with a 500-MHz Pentium III, 128MB of memory, a 10GB or larger hard disk, Microsoft Windows NT, and an Ethernet adapter. When all was said and done, we found that Compaq, Dell, HP, IBM, and Toshiba, in particular, have taken the managed PC closer to its ideal.

KEEPING TABS ON IT

The most important element in a managed PC is (not surprisingly) the remote-management application that the vendor sup-

plies with it. These packages are not to be confused with enterprise management tools such as CA-Unicenter and Tivoli (which are designed to manage multiple network environments and handle clients running multiple OSs) nor with packages like Microsoft SMS (which provides tools for remote control and software installation, as well as minimal hardware and software tracking). The midrange management tools included with these managed PCs are meant to inventory and monitor individual systems, extensively and actively, across contained, midsize Windows networks—though they sometimes do a bit more.

The most complete of these packages is HP's TopTools, which ships free with each Vectra. Launched from any machine on your network, TopTools can inventory (via Web-based protocols) any DMI 2.0-compliant system on that network, including non-HP machines. With HP clients that are loaded with HP-specific Web agents and specialized hardware, you can also update drivers, flash BIOSes, and monitor hardware—receiving alerts when memory has failed, hard disks are failing, temperatures or voltages are high, chassis have been opened, or fans have stopped. TopTools can even monitor the health of third-party machines, but only if those machines are designed to send alerts based on DMI or Simple Network Management Protocol (SNMP) calls.

Other vendors also supply effective management tools, but no one quite equals HP's solution. The Compaq and Dell applications are close—letting you take inventory, monitor health, and update BIOSes—but neither let us manage third-party PCs (though Dell's IT Manager should do so by the time you read this). All other machines reviewed here ship with Intel's LANDesk Client Manager, which lacks tools for updating drivers and BIOSes but is often the best tool for taking DMI inventory. It also lets you, to a varying degree, monitor health and is (like TopTools) a good way to manage machines from multiple vendors.

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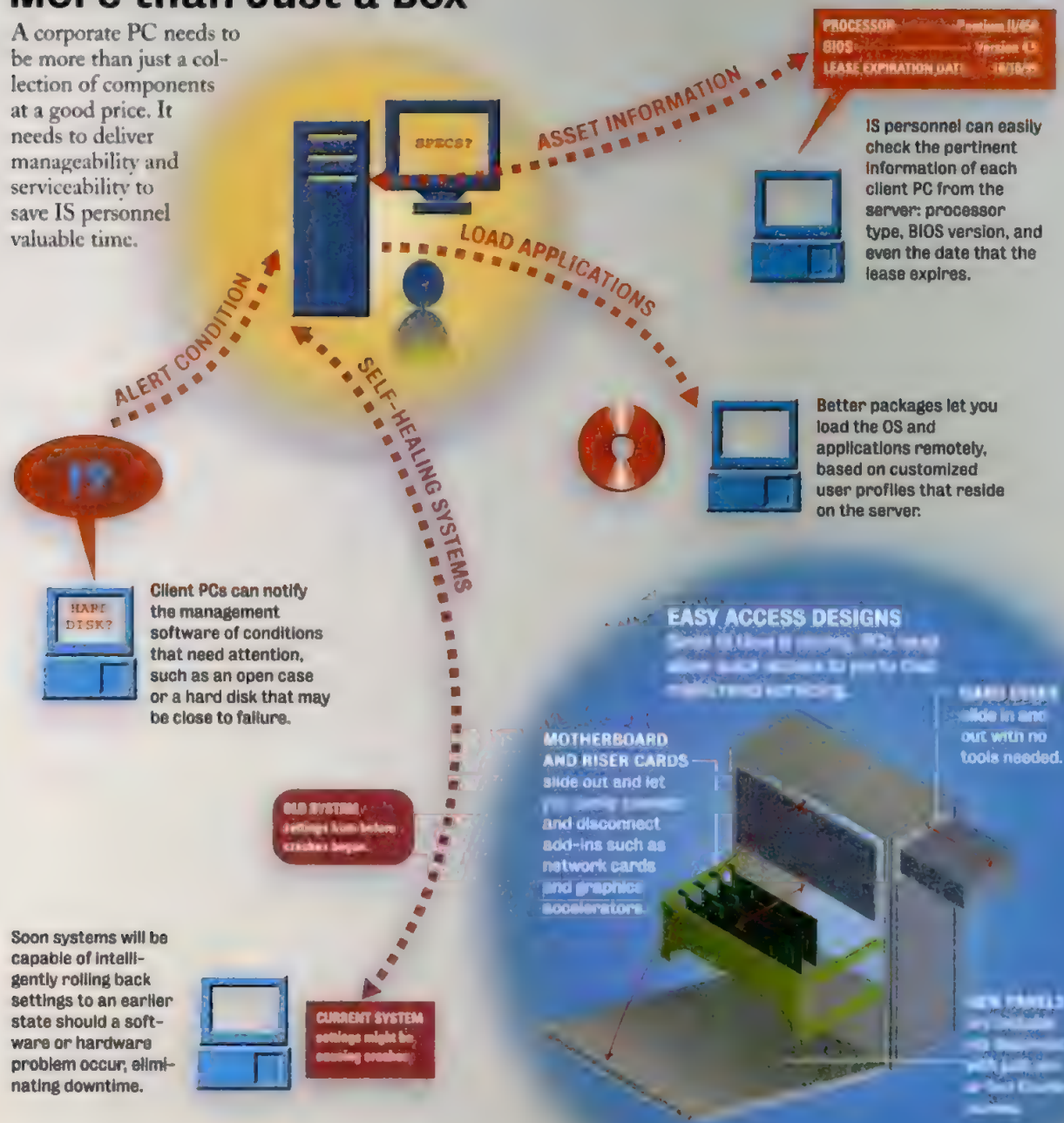
PCs

Today's corporate PCs are more than simply the sum of their hardware: Manageability and serviceability add to the equation. We test ten of the latest.

By Cade Metz

More than Just a Box

A corporate PC needs to be more than just a collection of components at a good price. It needs to deliver manageability and serviceability to save IS personnel valuable time.



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With IBM, LANDesk is a supplement to the company's UMA (Universal Management Agent) strategy. IBM clients can be inventoried and monitored from the company's UMA browser or from a larger management package such as Tivoli TME 10 or Microsoft SMS. The company provides a separate tool for remotely loading OS images.

To facilitate these many functions, each vendor also lets you remotely wake up, restart, and shut down machines. Remote function is a must when you need to load drivers, flash BIOSs, and—should you purchase additional tools—load software over the network.

GETTING INTO IT

Ideally, the management software would alert you before a problem brought down the machine completely and would even let you remedy the problem remotely. In a perfect world, too, you would have the money to replace machines before they needed to be upgraded. But the truth is that most corporate PCs will need to be opened at least once in their lifetime.

That's where chassis design becomes important: A good managed PC opens easily and lets you add or replace a hard disk, an adapter card, or the like quickly, with a minimum investment of time.

Though each PC reviewed here can be opened quickly without tools (not even a screwdriver), only half—the ones from Compaq, Dell, HP, IBM, and Toshiba—make things as easy once you're inside. The leading chassis design belongs to the HP machine (our Editors' Choice), whose motherboard and hard disks can be removed with the pull of a lever or the pinch of two tabs. Similarly, the Compaq and Toshiba systems let you easily remove their drives and motherboards, but neither is as convenient as the HP model. Though Dell's motherboard is fastened down with multiple screws and IBM's board can't be removed without first extracting a single remote screw, each system is otherwise cleverly put together.

How often does one remove a motherboard? Hopefully never. But keep in mind that a removable board is much easier to service should the need arise. Also, you can readily swap removable boards among PCs. Compaq, HP, IBM, NEC, and Toshiba each use the same board in

Editors' Choice

• HP Vectra VLi8 MT



This roundup represents the cream of the crop in managed PCs, and five of the ten we tested make excellent choices. One player stands out.

The HP Vectra VLi8 MT, our Editors' Choice, boasts the most tractable chassis on the market (just besting models from Compaq, Dell, and Toshiba), as well as a broad, remarkably effective TopTools management package. When used with HP clients, the Web-based management suite lets you wake clients up, take inventory, monitor health, flash BIOSes, and update drivers. A second bundled package provides software distribution, license metering, and remote control. And unlike most other management tools, TopTools can monitor and manage non-HP PCs on your network. HP is a few steps behind Dell, Gateway, Toshiba, and others when it comes to Web purchasing and



support, but the VLi8's excellent serviceability and manageability more than make up for lost points.

Although we liked the HP solution the best, four other players here deserve a close look. The managed PCs from Compaq, Dell, IBM, and

Toshiba are all quite impressive, offering modular chassis designs, extensive cost-saving policies for large customers, and very effective management software.

Particularly noteworthy is IBM's unique tracking solution: Asset ID. Using a handheld radio-frequency tracker (about \$3,000 street), you can read from and write to the EEPROM housed in IBM's corporate PCs to check or change system and user information. For large installations, it's worth a test drive.

multiple systems. With a single board for multiple systems, you can likewise use a single OS image, simplifying the deployment and refurbishment of machines.

Corporate users have also expressed concern over how stable PC platforms stay over time—that is, how long a particular machine will be available after you first purchase it. If you prefer to buy many PCs from a particular vendor—slowly rolling out new machines to users and planning to swap parts and OS images among those PCs—it's comforting to know that you can purchase similar machines in the future. Thus most of the vendors here promise to maintain their platforms for at least 12 months after the line is introduced.

Because stability is an issue, managed PCs are rarely equipped with cutting-edge hardware. They typically ship with stable parts that a vendor can sell over a long period of time. Thus, the ten PCs reviewed here are not necessarily the fastest on the market. They're certainly good performers, though, and any of them should prove more than adequate at running typical office applications for years to come.

BETTING HELP WITH IT

A managed PC is more than the sum of its parts. It must also be judged on its manufacturer's service and support, which—in this age—means more than warranties

Our Contributors: CADE METZ is a senior staff writer at *PC Magazine*, and BRUCE BROWN is a contributing editor. MARY E. BEHR is a staff editor of *PC Magazine*. RICH FISCO was the project leader, and JAMIE M. BSALES was the editor in charge of this story.

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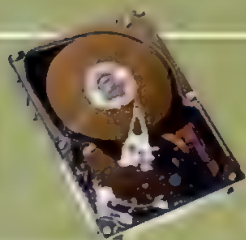
25 OF THE 25 TOP PERFORMING COMPUTER SYSTEMS USE SEAGATE DISC DRIVES.

HMMM. WITHOUT OVERTHINKING THINGS, IT LOOKS LIKE THERE'S
A STRONG CORRELATION BETWEEN HIGH PERFORMANCE COMPUTER
SYSTEMS AND HIGH PERFORMANCE SEAGATE DRIVES.

Have you heard of TPC? (AKA the Transaction Processing Performance Council.) Basically it's a highly professional non-profit group that tortures computer systems to the limits of performance to establish benchmarks. Recently, at TPC's grueling server trials, it turned out that every one of the top 25 highest performing servers used Seagate disc drives. Specifically Cheetah®, the world's fastest. Technically speaking, it was a slam dunk. This is important to know, because disc drives can account for up to 39% of the cost of a high performance server. Which is why, when all the top server brands wanted their money's worth, they chose Seagate. Who else?

FYI  www.seagate.com/disc1
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FYI



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9.1 GB, F & 18.2 GB, F	18.2 GB, F & 36.4 GB, F & 50.1 GB, F	9.1 GB, F & 18.2 GB, F	18.2 GB, F & 36.4 GB, F
Ultra SCSI (9LP) Ultra2 SCSI Fibre Channel	Ultra SCSI (18) Ultra2 SCSI Fibre Channel	Ultra2 SCSI Fibre Channel	Ultra2 SCSI Fibre Channel
7,200	7,200	10,000	10,000

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 **Seagate.**
Information the way you want it...

and help lines. Manufacturers' Web sites now provide myriad support tools, including driver updates, white papers, troubleshooting wizards, and bug fixes.

Naturally, most vendors let you purchase machines over the Web as well.

But Compaq, Dell, HP, IBM, and Toshiba go a step farther: Customers who frequently purchase systems in bulk can have customized Web pages and Web-related services that further simplify buying and support.

Unlike with other PC purchases, with managed PCs, performance takes a back seat to chassis design, remote management, and vendor support. The reviews that follow should help you pick the right vendor for the long haul.

REVIEWS

AcerPower 6100

Pentium III/500, 9.8GB disk, 17" monitor. Business Winstone 99: 28.1. \$2,180 street. Warranty: 3 years parts, 1 year on-site labor. San Jose, CA; 800-733-2237, 408-432-6200; www.acer.com/aac.

● The AcerPower 6100 is inexpensive and adept, delivering a strong LANdesk implementation and allowing relatively easy access to its internal hardware. Less potent than the managed PCs offered by such vendors as HP and Toshiba, the machine does have flaws: It provides scant room for expansion and—at present—benefits from little online technical support.

Acer wins some points for its 6100 chassis design. Its exterior casing is easily opened and its main drive cage swings out to facilitate upgrades, though the system's motherboard can't be removed without a screwdriver and considerable effort. Acer uses the same motherboard across several case designs, and that continuity is welcome if you are deploying a range of systems. The diminutive size of the 6100 case—2 or 3 inches shorter than the average minitower—is a double-edged sword: It's great if cubicle space is at a premium but offers little room for expansion. Only two drive bays and two bus slots can accommodate new components.

Acer bundles LANdesk Client Manager for DMI querying and uses the package to its fullest. From a remote console, you can receive inventory data as well as temperature, voltage, hard disk, and chassis intrusion alerts. Acer hasn't augmented LANdesk with tools for updating drivers or flashing BIOSes remotely, but it does meet the industry standards.

Unlike Dell, Gateway,

Toshiba, and others, Acer hardly uses its Web site to the fullest. Operating on an indirect sales model, the company does not let you purchase machines over the Web, and what little support it offers online is poorly presented and difficult to get at. To wit, most driver updates and other help files specific to the 6100 are buried on an FTP server, not neatly posted on a Web page. Sometime later this year, however, the company plans to offer a new site (www.acersupport.com) that will provide improved online services.

The 6100 performed relatively poorly on our Graphics WinMark tests, relying on an ATI 3D Rage Pro Turbo accelerator. Raw disk performance was also disappointing (its 9.8GB drive is the smallest in this roundup), and its Winstone score was a touch below average. Such deficiencies may be just barely noticeable during everyday operation, but they're another thing to take into account as you consider the competition from Dell and HP.—Cade Metz

Compaq Deskpro EN 6500+

Pentium III/500, 21.6GB disk, 17" monitor., Business Winstone 99: 33.9. \$3,080 street. Warranty: 3 years parts, 1 year on-site labor. Houston; 800-345-1518, 281-370-0670; www.compaq.com.

● With the Deskpro EN 6500+, Compaq has fashioned a modular system that's not only easily queried from a remote console but easily upgraded and repaired as well. At present, Compaq's basic PC management tool deals solely with Compaq machines (giving HP a leg up in this roundup), but Insight Manager is an otherwise capable package.

The Deskpro's higher price relative to the others' nets you a generous 21.6GB hard disk plus a biometric security system that checks user fingerprints before allowing access to the network or to protected portions of the hard disk. The Deskpro mini-tower is wonderfully easy to service, offering a tool-free chassis and readily removable components. The motherboard easily slides out for servicing. After you

remove the system's front panel, you can also quickly remove (again, without tools) all external drives.

The Web-based Insight Manager isn't as refreshingly simple as the Deskpro mini-tower. We had to spend time with tech support to get the package to see clients on our network. Once running, however, Insight Manager is a powerful tool that lets you conveniently inventory and monitor Compaq PCs across a network, send system alerts to an e-mail account or pager, and print out detailed system reports on individual machines. Though an upcoming version will be able to manage third-party PCs, Insight Manager currently reads only



www.pcmag.com/hotlinks

Customizable, interactive versions of the benchmark test results and features table are available at our site. For more on PC management, see these other sites.

► Desktop Management Task Force

www.dmtf.org

The spec section of the Desktop Management Task Force Web site includes information about the DMTF's Desktop Management Interface (DMI) and Common Information Model (CIM) standards specification. Included are links to software development

kits, tool downloads, and background documents.

► Intel

<http://developer.intel.com/support/desktopmgmt>

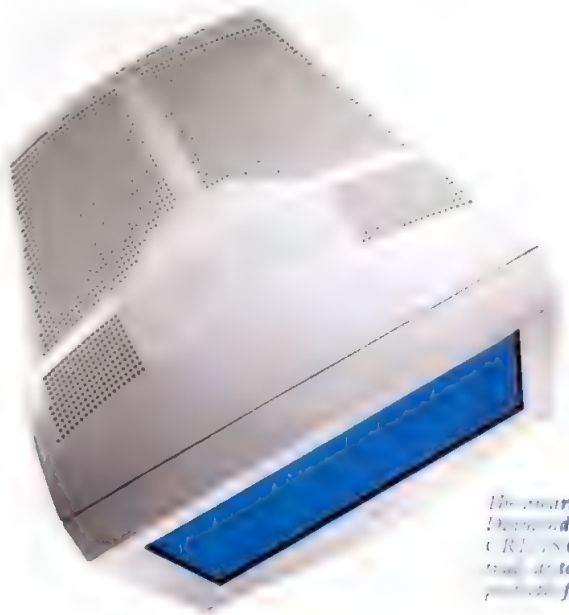
A site for General Remote Wake-up Questions from the Wired for Management initiative. The site also offers white papers, troubleshooting, and drivers.

► Microsoft

www.microsoft.com/hwdev

This site links to a white paper on Wired for Management, an initiative from Microsoft and Intel aimed at reducing computing costs via hardware management.

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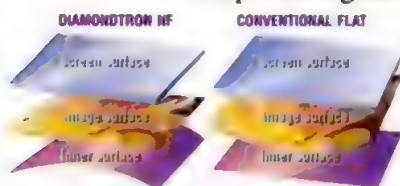
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from the Web-based agents that reside exclusively on Compaq PCs. On the upside, these agents can also be read by HP's TopTools. Compaq bundles a second package known as System Software Manager that will remotely update the Desktop BIOSes and drivers.

Performance on our benchmark tests was among the best in this roundup. The Deskpro also ships a fingerprint reader that bars unauthorized users from entering the OS. The advantage here is that, unlike HP's Smart Card-based method, there's little danger of losing the item that affords access to your PC.

Compaq now sells PCs over the Web and provides impressive support tools online. For large companies, Compaq provides private sites and guarantees that each Deskpro model purchased will remain available for 6 to 12 months. While HP's TopTools make its line our favorite, this Compaq series is a close runner-up.—*CM*

CompUSA American Pro 500

Pentium III/500, 12.8GB disk, 17" monitor. Business Winstone 99: N/A. \$2,000 street. Warranty: 3 years parts, 1 year on-site labor. Dallas; 888-266-6772, 508-480-8500; www.compusa.com.

● A generically standard system that boasts a relatively low price, the CompUSA American Pro 500 is a few steps behind the offerings from leaders such as Compaq and HP when it comes to manageability and performance. It lacks features designed specifically to support easy and comprehensive corporate upgrades, maintenance, and management.

The model we tested is a typical Intel-based PC, complete with an Intel motherboard, Intel NIC, and Intel LANDesk Client Manager 3.3. It is equipped with a 5,400-rpm hard disk, which held back performance on our Disk WinMark and Winstone tests compared with the higher-throughput 7,200-rpm disks used by other systems in this roundup. More damning is the CompUSA's lack of easy hardware upgrade provisions such as tool-free motherboard replacement and drive switching. Also, its limited health-monitoring features don't recommend it to IT managers looking for easily managed systems they can maintain remotely.

The American Pro 500's LANDesk Client Manager reports most configura-



To assess the **purchasing online** and **post-purchase support** categories, we examined the vendor's Web site and support policies, checking such factors

as whether the Web site offered BIOS and driver upgrades, a troubleshooting wizard, an order status link, and data encryption. Considerations for the **manageability** and **serviceability** ratings include such factors as whether the case opens without tools and whether the management package lets you wake up clients, take invento-

ry, monitor health, flash BIOSs, and update drivers.

Our Editors' Choice, the HP Vectra VL8 MT, was dinged under post-purchase support, receiving a *fair* because of limited free phone support (available only for the product's first year). Also, while PCs are available for purchase from HP.com, they can't be custom-configured, and orders must be fulfilled through resellers. On the other hand, HP's management package, Top Tools, is brilliant, and the unit's chassis is remarkably easy to service; these attributes led to excellent scores for manageability and serviceability.

	Purchasing online	Post-purchase support	Manageability	Serviceability
AcerPower 6100	Poor	Poor	Good	Good
Compaq Deskpro EN 6500+	Good	Excellent	Excellent	Excellent
CompUSA American Pro 500	Good	Fair	Fair	Fair
Dell OptiPlex GX1p 500	Good	Excellent	Excellent	Good
Gateway E-4200 500	Excellent	Excellent	Good	Fair
HP Vectra VL8 MT	Fair	Fair	Excellent	Excellent
IBM PC 300PL	Fair	Excellent	Excellent	Good
NEC PowerMate ES 5200	Good	Good	Excellent	Fair
Quantex SB500	Good	Good	Good	Fair
Toshiba Equium 7100M	Excellent	Excellent	Excellent	Excellent

tion options locally, with the same information viewable via LANDesk on a server and via HP TopTools. Not everything is reported, however; serial numbers, audio devices, and memory upgrade options are missing. While the system does support hard disk failure prediction, remote rebooting, and Wake on LAN, it doesn't report chassis intrusion or thermal, fan, and voltage levels and alarms.

The American Pro 500 has the advantages of a national distribution system, Web-based sales, company-owned retail locations, and an outbound direct sales force for government and corporate sales. CompUSA's Web site services are rapidly developing and changing, both for selling and supporting systems. Current support includes driver and BIOS updates, bug fixes, and an options list. A site under development promises to add online documentation, a troubleshooting wizard, and premium pages for large customers.

The warranty (three years parts, one year labor) includes on-site service for the first year, but 24-hour parts replacement is not available. If price is your primary concern, the CompUSA isn't a bad choice; just be aware that other vendors offer more bang for that buck.—*Bruce Brown*

Dell OptiPlex GX1p 500

Pentium III/500, 19.5GB disk, 17" monitor. Business Winstone 99: 34.4. \$2,100 street. Warranty: 3 years parts, 3 years on-site labor. Round Rock, TX; 800-915-3355, 512-338-4400; www.dell.com.

● Though Dell's Web-based management tool was still in development as we tested the Dell OptiPlex GX1p 500, what we did see from the tool bodes well for the company's managed PC platform—which already boasts a slick chassis design, impressive internal hardware, and an attractive price tag that makes it one of our favorites in this roundup.

The OptiPlex is one of the least expensive systems in our roundup. But note that Dell equipped our test system with an STB Velocity 4400 (a \$129 option) powered by a 16MB nVidia RIVA TNT chip set—even though the motherboard has an ATI Rage Pro Turbo chip on it already. Whether that's a true value add or simply a way to boost the OptiPlex's benchmark test scores depends on your point of view; we feel that most corporate administrators should not opt for the upgrade unless their users need speedy 3-D graphics.

The Dell management platform begins with the OptiPlex chassis, which years after



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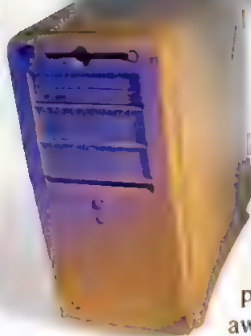
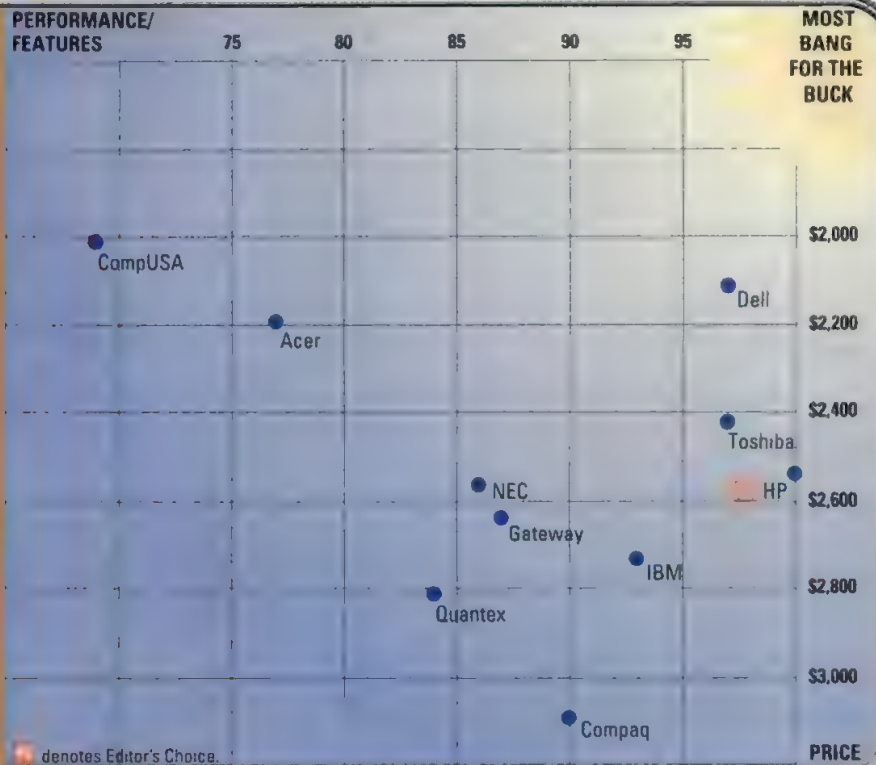
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The units from Dell, Hewlett-Packard, IBM and Toshiba scored in a cluster of excellence on our price/performance ratio. Dell comes in with the lowest price tag of the four (\$2,100) while IBM (\$2,720) is pricier than the Toshiba (\$2,410) and the HP (\$2,525). All offer terrific manageability, with HP's TopTools software leading the pack, pushing the unit to the top "bang" score. Dell used Dell IT Assistant, IBM used DMI 2.0 Universal Management Agent, and Toshiba used LANDesk Client Manager 3.31. These vendors also got points for long warranties and/or around-the-clock technical support, as well as easy-to-service cases and room for expansion.

The Data Points

Manageability accounted for 44 percent of the "bang for the buck" score. This category included such features as chassis intrusion alarm, remote reboot, remote shutdown, support for hard disk failure prediction, and third-party inventory, to name a few. The other categories included performance (10 percent), support policies (10 percent), components (18 percent), and expansion potential (18 percent).



Dell was a pioneer in chassis design, and this OptiPlex shows it.

The Dell IT Assistant management suite isn't as comprehensive as HP's TopTools, but it adequately manages OptiPlex machines and will, Dell claims, soon handle third-party PCs as well. With IT Assistant, you're able to manage the OptiPlex from anywhere on your network. IT Assistant doesn't offer such well-organized, multiple-machine reports as TopTools does, and it merely exports staid files to the leading enterprise packages rather than fully integrating with those packages, but it's a proficient, self-contained package.

Additionally, Dell's service and support offerings are exemplary—over the phone, over the Web, and on-site. Most notably,

its debut still seems innovative. The chassis is lockable but readily opens (without tools) to reveal a modular interior. A riser card holding the machine's bus slots is easily removed, while its power supply swings away from the motherboard on hinges. All external drives can also be removed and installed without tools.

each OptiPlex ships with an Express Service Code, which when keyed into the Dell Web site can provide driver updates, BIOS updates, and other fixes specific to the system's hardware and software. Dell also provides customized support and sales Web pages for large corporate customers.

Though the more robust TopTools gives the HP offering a leg up in our estimation, the attractive price and unbeatable support make the Dell nearly as worthy.—CM

Gateway E-4200 500

Pentium III/500, 17.2GB disk, 19" monitor. Business Winstone 99: 34.9. \$2,630 street. Warranty: 3 years parts, 3 years on-site labor. North Sioux City, SD; 800-846-2000, 605-232-2000; www.gateway.com.

● The Gateway E-4200 500 delivers strong system performance and comprehensive manageability. Complete Web-based purchase and support programs add to the appeal. But in general, the machine does not stand out from the crowd, as do the offerings from Dell, HP, and Toshiba.

For one, Gateway hasn't caught up to the leaders in case design. The case opens with two thumbscrews, but otherwise maintaining and upgrading the Gateway's hardware components is no easier than with a regular PC. In its favor, the E-4200's

mini-tower case supports memory expansion to 384MB and has a total of eight drive bays (second in this roundup only to the Quantex), and the attractive price includes a 19-inch monitor. On benchmark tests, the Gateway had an excellent showing, thanks to its very fast ATI Rage 128 GL graphics card and its 7,200-rpm Western Digital hard disk.

Intel LANDesk Client Manager comes installed on the Gateway system, and in testing, the program was able to detect and report chassis intrusion locally and via servers running LANDesk and HP TopTools. Although support for fan speed isn't included, the E-4200 does monitor and send alerts if case temperature and voltage exceed set limits. Wake on LAN, remote reboot, and remote shut down all work properly.

Gateway's Web-based support and sales resources are broad and complete. Support features include a troubleshooting wizard, complete online system documentation, software patches, and driver and BIOS upgrades. Large corporate customers can also access premium support pages with account and order management and specific support resources. But corporate customers can't execute a sale online, as can individual customers: The order

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demands reliable, around-the-clock

So who watches the store when the stock market opens in Singapore, when the Sydney office must confirm a delivery schedule right now, or when a night owl in Sheboygan wants to place a catalog order this minute?

The answer, of course, is information systems. And these days, the emphasis is on information — or, more precisely, content. That's because without content, systems don't have anything to do. An organization's customers, prices, orders, e-mail — all this is data, and without it, your business and your customers' businesses grind to a ruinous halt.

A deluge of data

Meanwhile, as we increasingly rely on information systems to keep business humming all the time, we're generating vast quantities of content that must be reliably stored and, often, quickly accessed by numerous people in far-flung locations.

For several years, experts have pointed to data volumes growing by at least 50% to 60% a year, thanks to electronic commerce, data warehouses and information-intensive applications focused on enterprise resources management, multimedia, e-mail and so on.

It all adds up to an enormous appetite for network-centric data storage, an appetite that, according to International Data Corporation (IDC), has been doubling annually for several years and will continue to do so for several more. By the end of this year, IDC has predicted, demand for network

data storage will approach 60,000 terabytes. In 1995, network storage needs barely topped 5,000 terabytes.

Dealing with data storage around-the-clock

As volume mushrooms, keeping content both accessible and safe can be tough. It means every organization needs a comprehensive data storage strategy that meets your daily activity and backup requirements.

Today, data storage issues affect everything from network response and availability to budgets and staffing. However, increasing network complexity need not translate into management hassles. Instead, it should foster a growing partnership with a storage solutions provider whose goal is to help you manage and grow your business.

Most businesses with critically important content to store and protect look for products that:

- Support a wide range of applications with varying performance and capacity requirements,
- Deliver cost-effective fault-tolerance with RAID storage subsystems,
- Have high reliability,
- Enable installation of additional storage without putting further strain on general-purpose servers or requiring network downtime,
- Provide disaster recovery and high-performance backup solutions to fit the ever-shortening backup window.

However, selecting the right kinds of data storage products can be difficult, even risky, without expert help.

data storage

Get a data storage partner

The value of a data storage partner with best-of-breed products and vast experience cannot be underestimated. Just ask any organization that's suffered loss of data — and loss of revenue — because of a data storage failure.

Quantum Corporation designs and manufactures storage products for today's around-the-clock businesses. Widely recognized as the industry's quality leader and committed to being the industry's most diversified storage company, Quantum offers a variety of storage solutions ranging from the desktop to the data center.

What makes Quantum different? A commitment to consistently meeting customers' requirements in four key ways:

- **Quality.** Quantum is quality-conscious from the outset, through selection of high-reliability components and strict adherence to design margin analysis development phase. Quantum quality continues with extensive pre-production reliability testing, strategic use of automated manufacturing, long-term partnerships with high-performing suppliers and solid, consistent execution. Quantum's industry-leading product acceptance rates — in excess of 99.9% at major OEMs — is the result.
- **Use of technology.** Technology advances are occurring rapidly in the data storage industry. Quantum incorporates the newest proven technology to provide state-of-the-art products with industry standard interface options, data storage capacity and data access performance.

- **Time-to-volume production.** While introducing new technology to the world matters, ramping a product to production volume is even more important for those who will actually use it. Quantum climbs product manufacturing ramps faster than any supplier in the industry. Quantum's Fireball™ family of products ramped from zero to ten million drives in just three quarters of production, the storage industry's fastest ramp on record.

- **Ease of doing business.** Quantum delivers products that can be counted on, along with worldwide logistics capabilities, regional service delivery and dedicated customer support teams for all customers.

Quantum: Products for all your data storage needs

What kind of data storage is best? Of course, the answer depends on the nature of your business: How important are storage-intensive applications? Do you need exceptionally fast access to them? Are reliability and data integrity of particular concern? Is data management becoming more and more difficult? What about scalability? Do you need hot swapping capability?

Quantum's broad range of products can meet all your data storage requirements.

High-end hard disk drives

Quantum designs, develops and markets technologically advanced 3.5-inch hard disk drives for the

Why Hewlett-Packard specifies Quantum drives in its PCs

When you've built your reputation on the reliability of your products, there's simply no room for compromise on the reliability of the components you purchase from suppliers.

That's why Hewlett-Packard Company — named #1 in reliability for personal computers by IDC and Dataquest — specifies Quantum hard disk drives for its corporate and small-business computers.

The reliability customers demand

HP's customers have come to expect industry-leading reliability from the company's PCs. Consequently, HP's Commercial Computing Division general manager, Eric Cador, demands the same high level of reliability from his suppliers.

"For most of our customers, data is the most important part of the computer," says Cador. "If they experience loss of data, what they see is a system failure, not a hard drive failure. And that causes them to lose confidence in HP, not the supplier of the hard drive. For HP, it's an issue of customer satisfaction: that's why it is essential for us to specify reliable hard drives and other components for our PCs. Quantum offers excellent reliability at a reasonable price."

From a dependable partner

Cador also values Quantum's dependability as a business partner. "Their supply chain initiative ensures just-in-time delivery," he explains. "They make sure our inventory is limited, getting us just the product we need when we need it."

Plus, he adds, the two companies have a good business relationship, with joint design, qualification, sales and marketing efforts.



www.quantum.com/nonstopbusiness/

The difference between success and failure: Connected Corp. protects road warrior data

Today's business "road warriors" live or die based on non-stop accessibility to the information they carry in their portable computers. That's why top finance, consumer goods, energy, telecommunications, networking and software companies depend on Connected Corporation and DLTape™ technology for protecting data for road warriors, telecommuters and enterprise network users.

Thousands of daily backups

Every day, thousands of Windows NT 4.0, Windows 95 and Windows 98 computers automatically link to Connected's Secure Data Centers, where they are backed up automatically. Data is encrypted and compressed on the PC prior to transmission to the Secure Data Centers. Hierarchical storage management (HSM) software at the Secure Data Centers transfers data from RAID disks to multi-terabyte libraries equipped with multiple high-performance DLT™ 7000 tape drives and dozens of 35 GB (uncompressed) tapes.

DLTape drives have "best combination"

Connected rarely hears from customers about the dramatic rescues it provides, because restores are totally automatic. Whether it's a single file or a full system restore, Connected returns the user's PC to its state of operation before the mix-up. "If customers lose files, they simply recover them automatically, and we never hear about it," says Carl Lazarus, vice president of operations. "Connected chose DLTape technology because it provides the best combination of

price, high capacity and fast retrieval time."

demanding storage needs of network servers, workstations, storage subsystems, and high-end desktop systems.

These 4.5GB to 36.4GB high-performance drives are designed for storage-intensive applications such as video, graphics, disk arrays, desktop publishing systems, multimedia computing systems, and networked databases and file servers.

RAID-ready. Quantum's Atlas™ high-capacity disk drives meet the toughest requirements of RAID subsystems, delivering the capacity, performance, and data integrity needed by the most demanding array applications and offering features that minimize an array's overall cost per megabyte. Among the best in the RAID-ready class, these drives reflect the experience of designers who trace their roots to the earliest days of disk arrays. Quantum's ASABET SCSI controller, used in Quantum Atlas, provides exceptionally low 100-ms command overhead and executes many functions in hardware to improve overall array throughput.

Hot-swappable. Quantum's Atlas III and Viking II Low Voltage Differential (LVD) drives are designed for use in "hot swap" applications, so users can remove potentially defective drives or upgrade capacity without the inconvenience and expense of taking down the entire system. Storage arrays and/or SCSI buses using Quantum Atlas III and Viking II disk drives will be "Hot Swap Level 4"-tolerant.

DLTape™ systems and tape automation

Quantum designs, develops, manufactures, and markets half-inch cartridge tape systems for protecting data stored on mid-range and high-end servers. Consisting of DLTape drives and DLTape cartridge media, Quantum's DLTape system uses advanced linear recording technology

and a highly accurate tape-guide system. These half-inch cartridge tape systems protect content stored on mid-range and high-end servers, delivering the highest capacity and performance, the broadest compatible scalability, backward compatibility, and impressive reliability and data integrity.

DLTape systems have become the industry-standard platform for data protection for mid-range servers and are incorporated into products by every major computer systems vendor, as well as nearly every major tape-automation vendor. For more information please visit www.DLTape.com/ProveIt.

Solid state disks

Ensuring lightning-fast access to the most important business content, Quantum's solid state disk drives deploy the high execution speeds required for such applications as on-line transaction processing, material requirements planning, scientific modeling, imaging, multimedia and video-on-demand.

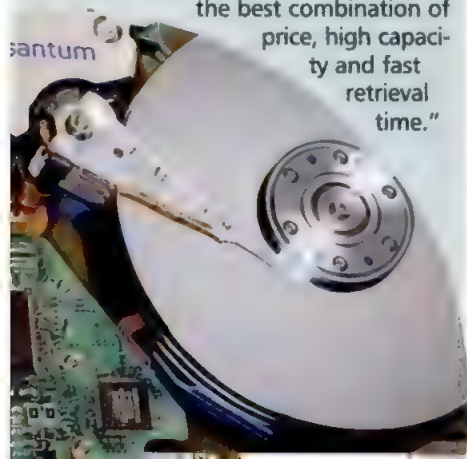
Quantum offers non-volatile and volatile solid state disks for applications — such as databases, RAID 5 configurations, the World Wide Web and sustained video streaming — requiring near-instantaneous I/O performance.

There are many ways that Quantum Corporation can help you meet your data storage needs cost-effectively without sacrificing performance, reliability or manageability.

Come see what Quantum can do for you in today's around-the-clock business environment . . .

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Quantum.



BENCHMARK TESTS

Managed PCs



Though performance certainly counts for corporate PCs, any system here is capable of running 2-D business applications acceptably. Focus on other buying criteria such as manageability and serviceability.

Since all these systems came equipped with the same 500-MHz Pentium III processor and 512K cache, the edge on our ZD Business Winstone 99 tests went to those with fast-spinning hard disks and top-performing 2-D graphics. The Gateway E-4200 500 edged out the Dell OptiPlex GX1p 500 for top honors. With slower hard disks and 2-D graphics accelerators, the bottom three finishers (the Toshiba Equium 7100M, the AcerPower 6100, and the NEC PowerMate ES 5200) fell off the pace set by the Gateway and Dell by 17 to 28 percent.

If you're running processor-intensive applications, look to the ZD High-End Winstone 99 for an assessment of system performance. Although faster disks and graphics chip sets helped the leaders, in this case we can point specifically to the graphics accelerator. The top three scorers—the Compaq Deskpro EN 6500+, the HP Vectra VLi8 MT, and the IBM PC 300PL—all used Ma-

trox G200-based graphics subsystems, and all scored closely. These graphics cards and drivers can apparently handle the graphics tasks along with all other system calls from applications like Adobe Photoshop, AVS/Express, Bentley Systems' MicroStation SE, and Microsoft FrontPage 98 better than the other cards can.

Most graphics found in typical business applications are 2-D (not the 3-D animation found in today's games), and just about any card found in current systems can handle such a load comfortably. The top three performers on our ZD Business Graphics WinMark 99 tests used either ATI Rage 128 or Matrox G200 chips to power their graphics subsystems. Although the HP Vectra VLi8 MT had a G200-based chip set, it had the oldest driver among the G200s, which contributed to its scoring behind the top two G200-based systems by 21 and 27 percent.

Using applications that are more CPU-intensive and contain more 3-D graphics, the ZD High-End Graphics WinMark 99 tests interact differently with graphics subsystems compared with the Business Graphics WinMark 99. This time, cards based on the ATI Rage 128 and nVidia RIVA TNT chip took top honors. Interestingly, Dell chose to add an STB Velocity 4400 PCI graphics card based on the nVidia RIVA TNT chip to its OptiPlex GX1p 500. Since the OptiPlex already comes with an ATI Rage Pro Turbo chip on the motherboard, upgrading to a powerful 3-D card like the STB Velocity 4400—at an added cost of \$129—doesn't make much sense for most corporate users—though it does boost benchmark test scores nicely. The CompUSA American Pro 500 uses a

new chip from nVidia, the Vanta. The Vanta is a low-cost version of the TNT2 graphics accelerator, and its 64-bit interface versus the TNT's 128-bit interface is the reason for its average performance.

For hard disks using the latest technology, the faster the disk spins the better its performance on our ZD Business Disk WinMark 99 tests. While having more data per track and a faster track-to-track seek time can affect

High scores are best. Bold type denotes first place.		ZD High-End Winstone 99	ZD Business Graphics WinMark 99	ZD High-End Graphics WinMark 99	ZD Business Disk WinMark 99	ZD High-End Disk WinMark 99	ZD CPU Mark 99
Editors' Choice		ZD Business Winstone 99					
AcerPower 6100	28.1	30.9	105	308	4,040	10,200	38.5
Compaq Deskpro EN6500+	33.9	33.2	210	385	5,960	14,400	38.4
CompUSA American Pro 500	N/A	25.3	149	378	3,290	6,450	38.2
Dell OptiPlex GX1p 500	34.4	31.1	191	391	5,960	13,600	38.7
Gateway E-4200 500	34.9	31.9	211	405	5,870	13,600	38.2
HP Vectra VLi8 MT	33.3	32.4	154	355	5,940	14,200	38.6
IBM PC 300PL	29.9	32.0	194	372	6,130	14,000	38.4
NEC PowerMate ES 5200	28.6	26.4	97	324	4,070	6,730	38.4
Quantex SB500	30.2	N/A	193	387	3,160	6,160	38.2
Toshiba Equium 7100M	25.3	29.0	116	340	2,720	8,090	38.7

N/A: Not applicable. The product did not complete this test.

must be faxed or mailed to a designated corporate sales representative. This step is used to ensure that systems ordered for corporate customers meet predetermined customer specifications. After the order is placed, order status can be tracked online.

All Gateway desktop systems are sold with a three-year-parts warranty, but corporate systems also include full three-year on-site service coverage plus 24-hour, 7-day toll-free technical support and 24-hour parts replacement. There is certainly plenty to recommend the Gateway, but be sure to check the strong competition from Dell, HP, IBM, and Toshiba.—BB

HP Vectra VLi8 MT

Pentium III/500, 13GB disk, 17" monitor. Business Winstone 99: 33.3. \$2,525 street. Warranty: 3 years parts, 1 year on-site labor. Palo Alto, CA; 800-322-4772, 650-857-1501; www.hp.com.



Offering ample security, an ingeniously tractable chassis, and today's finest midrange management application, the HP Vectra VLi8 MT sits atop the managed PC market and is our Editors' Choice in a very strong field. A longtime market leader, HP not only provides a potent hardware and software platform but

allows that platform to interact easily with third-party machines. Though HP's standard support offerings aren't what they could be, the company does offer special services for large customers and now sells PCs over the Web.

The VLi8 was an admirable performer on our benchmark tests, but this is the least of its benefits. Notably, it's the first Vectra to use HP's ProtectTools Smart Card Accessory kit, which bars access to your PC unless the appropriate card number and PIN are provided. This sleek mini-tower also offers what may be the market's most accessible chassis. To

BENCHMARK TESTS

performance, high-performance drives designed at about the same time tend to use similar technologies and have similar data densities and seek times. The drives in these systems gave clearly delineated performances, with the 7,200-rpm drives easily besting the 5,400-rpm drives. The top performer was the IBM Deskstar 13GP in the IBM PC300 PL.

With identical processor cartridges that contain identical L2 cache and all but one system using Intel's 440BX chip set, it's no surprise that the ZD CPUmark 99 scores were so close. First and last places were separated by only a little more than 1 percent. The HP Vectra VLi8 MT was the only system not using the Intel 440BX chip set, opting instead for the 440ZX, a low-cost alternative. The 440BX supports dual processing, ECC memory, and a maximum 1GB of memory in four double-sided DIMMs. The 440ZX supports neither dual processing nor ECC memory and can have a maximum of 256MB of SDRAM in two double-sided DIMMs.—*Analysis written by Rich Fisco*

How We Tested

We tested all systems running Windows NT 4.0 with Service Pack 4 installed, and we installed the TCP/IP stack required by the High-End Winstone 99 tests. All systems had 128MB of RAM. Each system had an 8GB or larger (formatted) hard disk. We stripped each system's start-up configuration of all processes and tasks except for Systray, Explorer, graphics card control panels, and ActiveX controls. We set the resolution to 1,024 by 768 with true color and set the monitor's refresh rate to 75 Hz.

We used our benchmark test program **ZD Winstone 99** to measure performance on 32-bit Windows applications. Winstone 99 is divided into two parts: **ZD Business Winstone 99**, which focuses on mainstream applications, and **ZD High-End Winstone 99**, which emphasizes CPU and graphics-intensive applications. Our Business Winstone 99 tests measure the time a PC takes to execute a set of scripts that exercise eight office-suite Windows 98 applications and an Internet browser. The scripts include task switching between a suite application and the browser. Business Winstone 99 weights a PC's test timings based on the applications' unit market shares; it derives a composite number and converts that to a relative score. (The score is relative to the performance of a Dell Dimension Pentium MMX/233 with 32MB of RAM, at 1,024-by-768 resolution with 24-bit color, running Windows NT 4.0 with Service Pack 3. The reference score is defined as 10.0.)

Our High-End Winstone 99 tests measure the time a PC takes to execute a set of application scripts based on seven Windows NT ap-

plications. High-End Winstone 99 weights a given machine's seven timings equally, derives a composite number, and converts that to a relative score. (The score is relative to the performance of the reference machine described above, with a reference score of 10.0.)

ZD WinBench 99 measures a system's graphics, disk, processor, CD-ROM, full-motion video, and DirectDraw performance under Windows 98. Like our Winstone test program, ZD Graphics WinMark 99 and ZD Disk WinMark 99 are each divided into business and high-end sections.

The **ZD Business Graphics WinMark 99** and **ZD High-End Graphics WinMark 99** scores are based on a log of GDI operations used by the applications in the Business Winstone 99 and High-End Winstone 99 tests, respectively. The Business Graphics WinMark score and the High-End Graphics WinMark score represent the performance of each machine's graphics subsystem running a log of GDI operations using Windows 98 applications and Windows NT 4.0 applications, respectively. Both test scores are normalized to reflect performance relative to the reference system used for Winstone testing.

The **ZD Business Disk WinMark 99** and **ZD High-End Disk WinMark 99** scores are based on a log of disk functions used by the applications in the Business Winstone and High-End Winstone suites; they represent the performance of each machine's disk subsystem under Windows 98 and Windows NT 4.0, respectively. We record the results in thousands of bytes per second and convert them to a harmonic mean. We then weight this mean in the same way as the Business Winstone 99 and High-End Winstone 99 scores, respectively. This year's Disk WinMark tests have a larger memory footprint, matching Winstone's footprint. Disk caching utilities that exploited the difference between Winstone's footprint and Disk WinMark's footprint to enlarge disk caching and thus enhance scores under Disk WinMark are no longer valid.

ZD CPUmark 99 is a new processor-subsystem benchmark test that replaces the current processor test in ZD WinBench 99. CPUmark₃₂. CPUmark 99 lets you measure the speed of a PC's processor subsystem, which includes the CPU, RAM, and RAM cache. CPUmark 99 emulates the CPU activity of the real-world 32-bit applications in Business Winstone 99; specifically, the instruction mix, percentage of L2 cache misses, and branch prediction algorithms used in today's processors. CPUmark 99 has a much larger memory footprint, and its cache characteristics are much more representative of modern applications. Since the applications in Business Winstone 99 do not use floating-point or MMX instructions, neither does CPUmark 99.

reach the system interior, you merely lift a handle and remove a side panel. You can then open panels on the front of the system (where drives can be removed without tools) and underneath the system (where the motherboard slides out). This motherboard is used by all VLi8 PCs, allowing customers to keep the same OS image and the same hardware for multiple form factors.

Yet the crown of HP's platform is TopTools, a remote Web-based package that—when used with HP PCs—lets you wake clients up, take inventory, monitor health, flash BIOSes, and update drivers.

Able to integrate with enterprise management packages such as OpenView, TopTools can also wake up, inventory, and monitor all other PCs reviewed here. The product's interface lets users effortlessly organize multiple machine reports and print them out. A second bundled package provides software distribution, license metering, and remote control.

HP gives free phone support only for the product's first year but provides private sales and support for Web pages, as well as augmented warranties for large customers. Consumers can buy PCs from HP's Web site but (unlike with most other vendors)

such purchases are filled through resellers and can't be custom-configured.

HP's business model doesn't offer the convenience of some others, but the Vectra is a remarkable managed PC.—*CM*

IBM PC 300PL

Pentium III/500, 12.8GB disk, 19" monitor. Business Winstone 99: 29.9. \$2,720 street. Warranty: 3 years parts, 1 year on-site labor. Research Triangle Park, NC; 800-426-7255; www.ibm.com/pc/us.

● The IBM PC 300PL is a fine example of today's managed PC. It ships with an abundant array of management and asset-tracking tools, and its attractive price

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SUMMARY OF FEATURES

Managed PCs



	AcerPower 6100	Compaq Deskpro EN 6500+	CompUSA American Pro 500	Dell OptiPlex GX1p 500	Gateway E-4200 500	HP Vectra VL18 MT	IBM PC 300PL
Price of tested configuration (street)	\$2,180	\$3,080	\$2,000	\$2,100	\$2,625	\$2,525	\$2,720
Monitor (CRT size, in inches)	AcerView 76e (17)	Compaq S700 (17)	RIE DH-1764 (17)	Dell M770 (17)	Gateway VX900 (19)	HP 70 (17)	IBM G96 (19)
Processor	Pentium III/500	Pentium III/500	Pentium III/500	Pentium III/500	Pentium III/500	Pentium III/500	Pentium III/500
Installed SDRAM/Maximum RAM	128MB / 384MB	128MB / 768MB	128MB / 384MB	128MB / 768MB	128MB / 384MB	128MB / 512MB	128MB / 384MB
Installed L2 pipelined-burst cache	512K	512K	512K	512K	512K	512K	512K
Motherboard manufacturer	Acer	Compaq	Intel	Dell	Intel	HP	IBM
Chip set	Intel 440BX	Intel 440BX	Intel 440BX	Intel 440BX	Intel 440BX	Intel 440ZX	Intel 440BX
BIOS manufacturer and version	Acer 3.2	Compaq 68673	Phoenix 4.0 Release 6.0	Dell A04	Phoenix 4.0 Release 6.0	Phoenix 4.0 Release 6.0	IBM NVK141 1

COMPONENTS

Hard disk	Maxtor DiamondMax 3400	IBM Deskstar 22GXP	IBM Deskstar 13GP	Maxtor DiamondMax Plus 5120	Western Digital Expert AC418000	Maxtor DiamondMax Plus 5120	IBM Deskstar 13GP
Capacity	9.8GB	21.6GB	12.8GB	19.5GB	17.2GB	13GB	12.8GB
Supports UDMA / SMART	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Graphics adapter	ATI 3D Rage Pro Turbo	Matrox Millennium G200	Creative Labs Graphics Blaster RIVA TNT2 Value	STB Velocity 4400	ATI Rage 128 GL	Matrox Millennium G200	Matrox Millennium G200
Chip set	ATI 3D Rage Pro Turbo AGP	Matrox MGA-G200A	nVidia Vanta	nVidia RIVA TNT	ATI Rage 128 GL	Matrox MGA-G200A	Matrox MGA-G200
Memory	8MB SGRAM	8MB SGRAM	16MB SDRAM	16MB SDRAM	16MB SDRAM	8MB SDRAM	16MB SDRAM
CD-ROM drive	Hitachi GD-2500	Kenwood 52X TrueX	Artec ACD-400	NEC CDR-3000A	Mitsumi FX322M	Panasonic SR-B583B (DVD)	Goldstar CRD-8400B
Sound device	ESS Solo-1 ES1938S	ESS ES1869	Creative Labs Ensoniq AudioPCI	Cirrus Logic CrystalClear CS4236B KQ	Creative Labs Ensoniq AudioPCI	Cirrus Logic CrystalClear CS4280	Cirrus Logic CrystalClear CS4235 KQ
Audio synthesis	Wavetable	Wavetable	Wavetable	Wavetable	Wavetable	Wavetable	Wavetable
Network adapter	Intel Pro/100+	Compaq 10/100 TX PCI	Intel Pro/100+ Management	3Com Fast Etherlink XL	3Com Fast Etherlink XL	3Com Fast Etherlink XL	IBM EtherJet

MANAGEABILITY AND EXPANDABILITY

DMI browser	Intel LANDesk Client Manager 3.32	Intel LANDesk Client Manager 3.32	Intel LANDesk Client Manager 3.3, TiVol 3.2GA	Dell IT Assistant	Intel LANDesk Client Manager 3.31	HP TopTools 4.1	DMI 2.0, Universal Man- agement Agent
SNMP/hardware fault reports	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Policy management/Asset tracking	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Throughput monitoring	■	■	■	■	■	■	■
LAN wake-up	■	■	■	■	■	■	■
Remote power on and off	■	■	■	■	■	■	■
Remote BIOS update/component locking	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Component branding	■	■	■	■	■	■	■
Chassis intrusion alarm	■	■	■	■	■	■	■
Processor/case thermal alarm	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Fan monitoring	■	■	■	■	■	■	■
Power-supply voltage monitoring	■	■	■	■	■	■	■
Remote disk formatting	■	■	■	■	■	■	■
Remote software/OS deployment	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■	■ ■
Expansion-bus slots	2 PCI, 1 PCI/ISA	1 ISA, 4 PCI, 1 PCI/ISA, 1 AGP	1 ISA, 3 PCI, 1 PCI/ISA, 1 AGP	2 ISA, 3 PCI, 2 PCI/ISA	1 ISA, 3 PCI, 1 PCI/ISA, 1 AGP	3 ISA, 3 PCI	1 ISA, 2 PCI, 1 PCI/ISA, 1 AGP
Front-accessible drive bays (5.25" / 3.5")	1 / 1	3 / 1	2 / 3	3 / 1	2 / 1	3 / 1	2 / 1
Internal drive bays (5.25" / 3.5")	0 / 0	0 / 1	0 / 2	0 / 2	0 / 3	0 / 2	0 / 1
Parallel/serial ports	1 / 1	1 / 2	1 / 2	1 / 2	1 / 2	1 / 2	1 / 2
USB / 1394 ports	2 / 0	2 / 0	2 / 0	2 / 0	2 / 0	2 / 0	2 / 0
Power-supply wattage	145	200	235	200	200	120	150

SERVICE AND SUPPORT

Technical-support hours (eastern time)	24 hours, 7 days	24 hours, 7 days	24 hours, 7 days	24 hours, 7 days	24 hours, 7 days	8:30-8:30 M-F	24 hours, 7 days
Standard warranty on parts/labor	3 years/1 year	3 years/1 year	3 years/1 year	3 years/3 years	3 years/3 years	3 years/1 year	3 years/1 year
On-site service charge for 1 year	Included	Included	Included	Included	Included	Included	Included
24-hour parts replacement	■	■	■	■	■	■	■



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figuration Change Notification and a security utility that can disable the floppy disk drive and serial and parallel ports to protect information.

In network manageability testing, the ES 5200 reported chassis intrusion voltage level, temperature, and fan speed locally and when seen via servers running LANdesk and HP's TopTools. Its adherence to manageability standards should allow the NEC

unit to be administered remotely by any high-level management software.

While the current Web site does not include easy access to bug fixes or a troubleshooting wizard, NEC has partnered with Insight.com as a direct-channel Web-based selling agent, so that when you go to the Insight-hosted sales site, which includes full system configuration mixing and ordering, it looks and acts much like NEC's own site. Additionally, corporate customers are eligible for custom support pages with order history management.

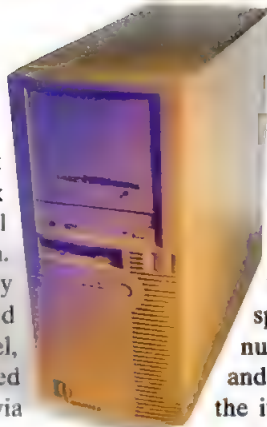
Although LANdesk isn't as robust as the proprietary packages from Dell, HP, and IBM, this NEC offering is still worth considering.—BB

Quantex SB500

Pentium III/500, 12.4GB disk, 19" monitor. Business Winstone 99: 30.2. \$2,800 street. Warranty: 3 years parts, 1 year on-site labor. Somerset, NJ; 800-346-6572, 732-563-4166; www.quantex.com.

● In a tough field, the Quantex SB500 is an adequate managed PC but not a standout. Most notable is the company's strong support for online buying, including system configuration and order checking. Otherwise, this is a middle-of-the-road offering bested here by competition from Dell, HP, IBM, and Toshiba.

The Quantex case, a tower with a large inverted U-shaped cover, is opened by loosening three thumbscrews. Unlike in units from leaders such as Compaq and HP, the interior components, including the motherboard, are not designed for quick swapping and maintenance. The capacious space (including a total of nine drive bays) does provide plenty of working room, however. Performance on most of our benchmark tests was average,



The Quantex Chassis offers room for expansion, including nine drive bays.

though the machine lagged most others on our disk tests.

When running the installed LANdesk Client Manager 3.32 locally on the Quantex, the system reported most component specs, although serial and asset numbers, manufacturer, model, and chassis details are missing from the items reported. It conforms to DMI 2.0 specifications and performed reasonably well in manageability testing, reporting all health status information except

chassis intrusion. Baseboard temperature, however, was reported at 4,294,967,249 degrees centigrade—likely an error on the high side. Other testing, including access via a LANdesk server and HP's TopTools, went smoothly.

Standard Web support includes a wide range of information, assisted by a troubleshooting wizard, although you cannot find system documentation online or a link to contact the company's technical support directly. Online system buying includes a guide to the process as well as an online system configuration tool and order status inquiry. By midsummer, high-volume customers can, by arrangement, access custom Web pages for an extra level of online support and account information. The SB500 comes with a three-year-parts, one-year-labor warranty with first-year on-site service included. Technical support is available 24 hours, 7 days, but there is no 24-hour parts replacement service.

The SB500 is an adequate machine. But in a field crowded with outstanding machines, there's no need to settle for adequate.—BB

Toshiba Equium 7100M

Pentium III/500, 9.6GB disk, 17" monitor. Business Winstone 99: 25.3. \$2,410 street. Warranty: 3 years parts, 1 year on-site labor. Irvine, CA; 800-867-4422, 949-598-7802; www.toshiba.com.

● Based on the Intel NLX motherboard, Toshiba's Equium series of desktop PCs provides continuity across several case types and CPUs, standardizing deployment and service for all buyers. Designed for easy access, quick servicing and upgrading, plus flexibility within a wide variety of managed environments, the Equium 7100M is a fine choice for a man-

aged desktop system, ably providing all the tools needed by network managers.

The 7100M has a unique chassis design. To open the case just slide a button that's located on the top of the system. This releases the top panel and one-third of the right-side panel. You can remove the rest of the right side simply by sliding it up and out, away from the chassis. The wide-open chassis affords plenty of room for the removal and replacement (both of which require no tools) of the motherboard, card riser board, and drives. The 7100M was not a performance standout, trailing the leaders on our Winstone and Disk WinMark tests, but not enough to remove it from contention.

Besides system servicing, the 7100M also excelled in system inventory querying and health status monitoring, locally and via servers running LANdesk or TopTools. For greater security, Toshiba will ship you an Equium with your company's Asset Tag already affixed, a \$15 extra.

Toshiba has excellent Web-based support

—providing drivers, patches, BIOS upgrades, system manuals, and Ask IRIS (Instant Response Information Service) Online. Ask IRIS Online is an impressive troubleshooting wizard that uses artificial intelligence to respond to real language queries, such as "How do I upgrade my BIOS?" Also, Toshiba's site links to resellers, both online and through distributors and mail order, since they do not sell their products directly from the Web. Large corporate customers have access via user names and passwords to a premium support site where they can find account history and support tailored to their buying patterns.

Toshiba's standard three-year parts-and-labor warranty is augmented by 24-hour, 7-day toll-free technical support, a free year of on-site service, and 24-hour parts replacement. Serviceable and manageable, the 7100M is a good bet.—BB PC



The Toshiba Equium delivers one of the most serviceable chassis we've seen.



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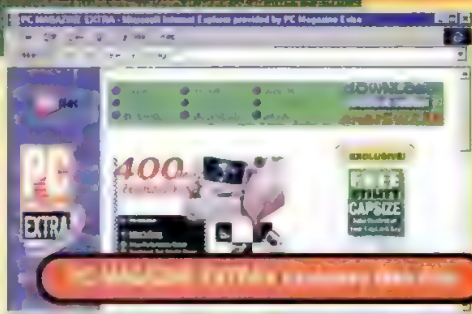
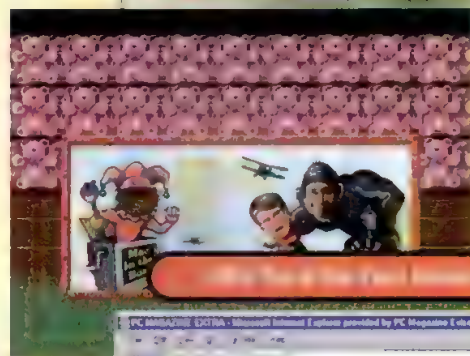
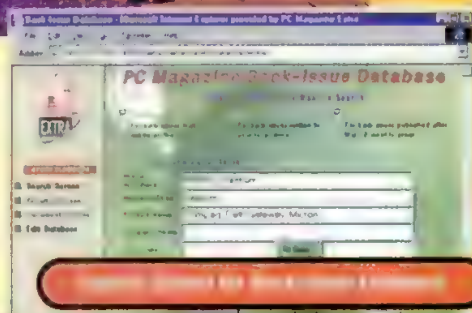
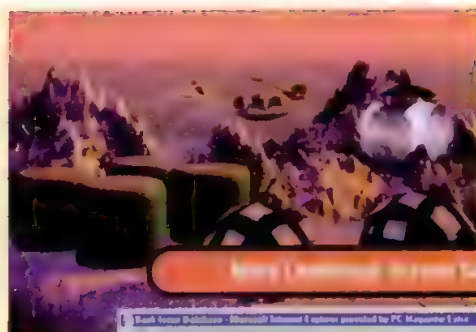
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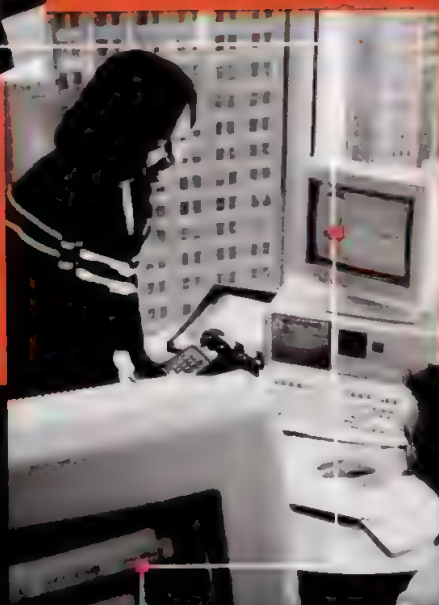


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INTERNET

1 in a box

Thin Internet servers provide easy Web access for your business.

By Robert
P. Lipschutz

If you're looking for Internet connectivity, Web access, and e-mail, along with basic network services—all bundled into a single, easy-to-use appliance—read on. Inexpensive, thin servers simplify the path to the Internet for small to medium-size businesses. These products generally consist of an embedded OS with features like e-mail and Internet access managed through a browser, network-connected hardware, a hard disk, a CPU, routing software, and an Internet connection (commonly a modem).

Thin servers are a growing new class of dedicated devices that include file servers, proxy/caching servers, mail servers, and database servers. They are well suited to small business environments because of their quick deployment and their low cost of ownership. The initial cost of the server is low, but the real savings is in cost over time in terms of managing and administering the products. Management is very straightforward; you don't have to deal with the complexities of the OS because all manipulation is done through a Web browser. And because there aren't any licensing fees for the OS or applications, the hardware and software together

are less expensive than traditional work-group servers. They're also cost-effective when compared with what small offices spend to maintain multiple analog lines, ISP accounts, and modems.

REVIEW CRITERIA

For this roundup, PC Magazine Labs reviewed seven thin Internet servers: the Cobalt Qube 2, Encanto Super e.go 210, eSoft TEAM Internet, FreeGate OneGate 150, Rebel.com NetWinder Group Server, Whistle InterJet II Model

New appliances like the Whistle InterJet II bundle all your Web-hosting needs into a neat package.



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What's in the Box

As evidenced by their wealth of features (and competitive prices), the Cobalt, FreeGate, and Whistle servers are strong contenders.

	WEB PUBLISHING UTILITIES	CONTENT MANAGEMENT	DOCUMENT INDEXING AND SEARCHING	WEB SITE FILTERING OR BLOCKING	DISCUSSION GROUPS	FIREWALL	REMOTE ACCESS
(1) Only via browser (2) Optional							
Cobalt Qube 2	★	★	★	★	★	★	★ ¹
Esanto Super e-go 210	★					★	★
eSoft TEAM Internet	★	★	★	★		★	
FreeGate OneGate 150	★	★		★		★	★
Rebel.com NetWinder GS	★		★		★		
INTERNET WHISTLE Whistle InterJet II 2200a	★			★ ²		★	★
WindDance Breeze NS							★

2200a, and WindDance Breeze Network Server. The Compaq NeoServers debuted too late to make our roundup. Each of the products reviewed is a server with an embedded OS and e-mail, Web, and routing services. With each product, you can expect a Web-based interface for both clients and administrators. Most offer file sharing, FTP, DNS, DHCP, and firewall capabilities, and some offer proxy, a Virtual Private Network (VPN), and access to Web-based discussions.

If you're connecting through an analog

dial-up circuit, just about any of these boxes will suffice on its own. If you want a dedicated link such as a T1, only three of the products—those from eSoft and Whistle, as well as the higher-end FreeGate model—provide one in the appliance. eSoft and FreeGate require a physical upgrade to the box; with Whistle, the interface is already present and is turned on with the purchase of an option key. For the rest, you'll need a separate router connected to a second Ethernet port.

Although these thin servers can ease much of the difficulty in setting up Internet connectivity and services, many complicating issues did come up during testing in our labs. For example, you'll need to understand specific aspects of your WAN connection, DNS, and e-mail service in order to make proper configuration choices. Plan on using a VAR or savvy technologist to help you make these decisions. Once installed all these products can be maintained by an office manager.

COLLABORATION AND COMMUNICATION

Each box we tested came with at least one type of content publishing. Each had at least one Web server and at least one way

to publish to it. The OneGate 150, the InterJet II 2200a, and the Breeze NS let you set up two Web servers, one each for Internet and intranet use. The Qube 2 goes farther, providing multiple virtual Web sites for individual users and groups. Publishing methods include FTP, Windows and Macintosh file sharing, and—in the case of the Qube 2—extensions to work with Microsoft FrontPage's Web authoring tool.

For communication, all products include an SMTP e-mail server, and most have both the POP3 and IMAP4 client access methods. Two of the products, the Qube 2 and the NetWinder GS, offer support for Web-based discussion groups.

NETWORKS 101

When considering these units, focus both on the set of network services offered and on the quality of those features. The services can include firewall, DHCP, DNS, VPN, and network address translation. During testing and evaluation, we found a number of details that can profoundly affect your installation. For example, only some of the products allow you to insert DNS entries manually.

Our Contributors: GREG ALWANG is a contributing editor of *PC Magazine*, and ROBERT P. LIPSCHUTZ and ROB SCHENK are frequent contributors. JEFFREY G. WITT is *PC Magazine's* technical director for networking and communications. RUSS IWANCHUK was the project leader, and JENNIFER TRIVERIO was the associate editor in charge of this story.



www.pcmag.com/hotlinks

Trying to connect your business to the Internet? *PC Magazine Online* is the first place to look for reviews of the products you'll need to make it happen. For more information on technology that can help you make the leap, see these other sites.

► Linux How-To Site

www.linux-howto.com

This site provides useful links to Web and Usenet sites that can help you decide whether you want to make your own Web server with Linux.

► The Internet Engineering Task Force

<http://ietf.org>

This somewhat dense, dry site discusses the latest efforts to set universal standards for data transmission on the Internet.

KNOW YOUR ISP

Most companies buying a thin server will use it in conjunction with an Internet connection furnished by an ISP. There are two basic connection options: standard dial-up and dedicated circuit.

The low-cost option is a single-user dial-up account. To accommodate this kind of connection, all of the products except the Qube 2 and the NetWinder GS (which have serial ports for external modems) have built-in V.90 modems. With a dial-up account, you'll get a TCP/IP address assigned dynamically each time you make a new connection. You can leverage the account for multiple network users, thanks to the network address translation (NAT) feature found on all of these products (except for the Super e.go and the NetWinder GS). This won't let you host Web or e-mail servers, however, because there's no way for an external DNS server to keep track of your ever-changing WAN IP address, and because your connection is probably down more than it is up. But you can still use your Internet appliance as an outgoing e-mail server that sends e-mail whenever the connection comes up. If all of this sounds too limiting, consider dial-up ISDN, which provides higher-speed access (up to 128 Kbps)—albeit at a higher price.

The more common connection option for businesses is to lease a dedicated circuit such as a T1 or fractional T1 line, along with a Class C address range (254 addresses) from your ISP. With this option, you get to choose your own domain name, and there's no time spent waiting for a dial-up modem connection.

On a monthly basis, a dedicated con-

editors' choice

• Whistle InterJet II Model 2200a



nection typically costs more than a dial-up connection, but some ISPs are offering dedicated DSL connections at amazing prices (Concentric Network offers a DSL connector for \$199 per month). The InterJet II 2200a and the TEAM Internet both offer optional T1 modules (T1 service will cost you about \$1,000 per month), and all of these products can be used with an external router that can connect to your ISP via T1 or other dedicated link options. So if you want your own domain name

example, offering an exceptional installation process, a highly intuitive, browser-based interface, and lots of other functions for the small office environment.

With its numeric keypad and LED display, installation of the InterJet II 2200a was flawless. The settings for Whistle Communications' ISP partners are already configured within the unit, but you can easily enter other settings.

The interface is organized by category and gives you access to the unit's impressive array of features, including Web access, FTP, DHCP, configurable

A good thin server needs to be feature-rich and easy to maintain. Our Editors' Choice-winning Whistle InterJet II Model 2200a (\$1,995 list) is a fine

example, offering an exceptional installation process, a highly intuitive, browser-based interface, and lots of other functions for the small office environment.

firewall/proxy, e-mail, cross-platform file sharing, Web site blocking, and optional remote-access and VPN support.

The InterJet II 2200a is scalable to ISDN, DSL, cable, and full T1 bandwidths. All are built-in; you merely purchase an activation key.

Good for those with an existing dedicated connection to the Internet and looking for a lower-priced alternative, the Cobalt Qube 2 earns an honorable mention. Its publishing features were the best we saw, and an application called InfoSpace provides low-end document management features, such as attributes and folder hierarchies.

and you intend to host your own servers, plan on paying more and getting your own Class C address range.

Once you've solved the ISP dilemma, you need to install and configure the Internet appliance on your network. Most boxes can use an existing DHCP server to obtain an address or can become the DHCP server for the network. Then you can configure each of the desired services.

You can expect some complexity in getting the e-mail, DNS, and DHCP to

Glossary

CGI Common Gateway Interface; a common method for transferring information between a Web server and a back-end application.

CSU/DSU Channel service unit/data service unit; a device that performs protective and diagnostic functions for high-speed telecommunications lines.

DHCP Dynamic Host Configuration Protocol; a system that assigns different IP addresses to devices each time they connect to the network. DHCP can support a mix of static and dynamic IP addresses.

DNS Domain Name Service; the process that translates Internet domain names (such as www.pcmag.com) into IP addresses.

IPSec IP Security; a set of protocols now being developed that will give greater IP-level security to data packets transmitted over VPNs.

NAT Network address translation; a technology that enables a network to use one set of IP addresses for internal traffic and a second for external traffic.

Perl Practical Extraction and Report Language; a flexible programming language especially designed for processing text.

POP Post Office Protocol; a standard protocol used for retrieving e-mail from a mail server.

PPTP Point-to-Point Tunneling Protocol; a new system designed to help create VPNs over the Internet and protect the data sent over public wires.

SMB Server Message Block; a common format for sharing files, directories, and devices in DOS and Microsoft Windows.

SNMP Simple Network Management Protocol; the protocols that manages networks. SNMP-enabled devices can communicate with each other.

VPN Virtual private network; a network that functions as if it were private, though it exists on public wires. Data is protected through encryption and other security mechanisms.

work just right, but once you've set everything up, you'll find that your office has become fully Internet-ready.

Cobalt Qube 2

\$999 list. Mountain View, CA; 888-702-6225; www.cobaltnet.com.

●The Cobalt Qube 2 is an excellent choice if you already have an Internet connection. It provides the most flexible Web publishing environment of any product in this roundup, and its well-designed interfaces for Web servers, Web discussions, and administrative tasks will please both users and administrators. Its bargain price of \$999 for a box with two 10/100 Ethernet ports makes it appealing for users with separate routers. Unlike the other products, the Qube 2 requires the purchase of an Internet connectivity device, such as a router or a modem.

You can post content through FTP as well as through Windows and Macintosh file sharing. The Qube 2 includes special extensions for Microsoft FrontPage's Web authoring tool and a application called InfoSpace, which provides low-end document management features such as attributes and folder hierarchies. The Qube 2 also includes a CGI interface and

The Cobalt Qube 2 is an excellent choice if you already have an Internet connection.



The installation of any technology-based product is always a concern for the buyer; it is particularly important for this product set.

These servers are targeted at customers who need low-cost hardware appliances, with preconfigured applications, that are easy to set up (without much expertise), manage, and maintain. The **implementation** rating takes these factors into account.

The **communication and collaboration** rating focuses on the e-mail, the Web-based discussion, and the remote-access features of the seven units tested. We look at the depth and breadth of the features—not only how many features each server offers but how well they work and how easy they are to configure.

The **network services** rating takes into account network-related issues, including firewall capabilities, security features, file sharing, blocking and filtering, and virtual private networks (VPNs).

	Implementation	Communication and collaboration	Network services
Cobalt Qube 2	Good	Excellent	Good
Encanto Super e.go 210	Fair	Fair	Fair
eSoft TEAM Internet	Good	Good	Good
FreeGate OneGate 150	Good	Fair	Excellent
Rebol.com NetWinder GS	Fair	Fair	Poor
EDITOR'S CHOICE Whistle InterJet II 2200a	Excellent	Excellent	Good
WindDance Breeze NS	Good	Fair	Good

mail server at predefined intervals to download users' e-mail messages to the Qube 2. Second, you can use multidrop POP, which allows the Qube 2 to download pooled messages from an ISP's multidrop POP account and separate the messages by recipient.

Basic network features—such as network address translation, a DHCP client and server, DNS, and an IP packet firewall—provide the necessary ingredients for a smooth network. Qube 2 doesn't include VPN capabilities or support remote access.

In considering this product you'll need to decide how vital things like discussion groups and document archiving are to your business. If they are important, this is your thin server. Be aware, you'll need to find your own ISP to provide your Internet connectivity, which will mean additional equipment costs. The Qube 2 is less expensive than the Whistle InterJet II Model 2200a, but the InterJet II 2000a includes numerous connectivity options and ISP relationships.—

Robert P. Lipschutz

Encanto Super e.go 210

\$1,495 list. Santa Clara, CA; 888-919-5199; www.encanto.com.

●The Encanto Super e.go 210 has a retail value of \$1,495, but the company has announced plans to give away the hardware

in exchange for a two-year service contract. Unique to this product are its commerce applications: If you're mainly concerned with e-commerce, this is the product to buy. But for general Web serving and e-mail there are stronger performers in this roundup.

The Super e.go 210's sleek gray case delivers all you need to get your business wired, with built-in Web, FTP, news, firewall, and e-mail servers. Its four-port 10Base-T hub helps integrate the device into your network (the hub is particularly useful if you're setting up a network for the first time). To configure the Super e.go 210, you can either use the serial port or gain access through the Ethernet adapter: The configuration process is simple, thanks to a wizard that quickly takes you through your PC's network settings. For administration tasks, you'll need either Internet Explorer or a special version of Netscape Navigator with the required Java Developer Kit, which Netscape provides.

Encanto's Instant Connect nationwide network costs \$69.95 per month for unlimited analog access via modem. ISDN access starts at \$99.95/month for single-channel 64K. The advantages of Encanto's service include remote diagnosis and updates, increased security, and site-mirroring. ISDN lines are supported, but pricing was not available at press time.

the ability to index and search HTML files.

The e-mail server handles SMTP, POP3, and IMAP4, and it provides auto-replies, forwarding, and aliases. Electronic mailing lists can include registered users as well as external recipients. The e-mail server has two special convenience features for dial-up users. First, you can configure the server to access an external e-



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2424M



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HP ProCurve 9308M, 4000M, 2424M, 2224 and 1600M prices are U.S. list prices effective 3/1/99. Savings claims based on U.S. list prices effective 2/22/99 for Cisco 2948-G and Cisco Catalyst 8540, 3Com SuperStack II 3300 and 3Com CoreBuilder 9000, Bay 450T and Bay Accelar 1200 in a large network. *HP ProCurve 9300 Series products have a 1-year warranty with extensions available. Market growth source: Dell'Oro Q3, 1998 for worldwide layer 2 switched 10/100 shipments. ©Hewlett-Packard Company.



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-hosted Web Services

For many businesses looking to establish a presence on the Internet, outsourced IP services are the way to go. With the most basic e-mail and Web hosting features, outsourcing can beat the cost of many Web appliances and off-load much of the hardware and service cost of managing a site.

Using an ISP may also negate the need for a costly, dedicated connection, because someone else hosts your site. You can also purchase additional services, such as e-commerce or virtual private networking, from the same vendor. And if you're not happy with your service, you can switch ISPs without getting stuck with unwanted hardware or software.

The trade-off is that you'll miss out on some of the added benefits of server appliances, such as built-in collaboration tools or the ability to have the unit double as a print server or Internet gateway. Also, without a local server, users may have to dial up to check e-mail.

ISPs currently offer a mix of business-centric services, ranging from Web hosting to dedicated servers. For about \$100 per month, MindSpring (www.mindspring.net) offers a "LAN on Demand" package for connecting a small office to the Internet via an ISDN router. Starting with ten e-mail accounts and 5MB of Web space, you can add features such as FTP support and a shopping cart. In addition to basic Web hosting, AT&T WorldNet (www.att.net) and Concentric Network (www.concentric.net) provide virtual private networking and managed high-speed connections. Concentric also hosts shared and dedicated servers. This relieves you of housing and managing your own server and gives you guaranteed uptime. (Concentric boasts 99.9 percent uptime since May 1997.) Costs vary depending on which services you use and the volume of traffic you generate, but generally range from \$50 to \$500 per month. —Greg Alwang

Using the bundled WebSite Builder software, novice users can quickly create a basic intranet site or Web site. The Super e.go 210 supports CGI and Perl scripting. To create your own e-commerce storefront using the StoreBuilder wizard, you simply enter the products and services.

The Encanto unit is the sole product in our roundup that handles e-commerce transactions.

Creating e-mail accounts is straightforward, but documentation is sparse. Management functions are quite limited; administrators aren't able to monitor the e-mail queue, create aliases, or configure mail account size limits (unlike the more robust Whistle and eSoft products). A built-in firewall provides security but

lacks configuration options. The device also lacks the VPN, Web-blocking, and remote-access support found in some of the other products. —Rob Schenk

eSoft TEAM Internet

\$2,195 list. Boise, ID; 888-903-7638; www.esoft.com.

● The eSoft TEAM Internet is a well-rounded offering, though using some of its features requires more computer savvy than the novice will possess. We were impressed with its ease of installation, good manageability, and robust feature set.

The TEAM Internet boasts a wide range of services including Web access, e-mail, firewall, remote access, and FTP serving. The unit also acts as a Windows file server. You configure the device

through an easy-to-use, Web-based interface. You can either select from a list of supported ISPs or enter an unlisted ISP manually. The device can scale to ISDN, DSL, cable, or frame-relay bandwidth speeds, but you'll need to install upgrade hardware or a swap box.

You can create Web sites quickly by using the bundled Claris Home Page Lite software. CGI scripting is supported but must be enabled in the administrative interface. For added redundancy, your Web site can be mirrored to your ISP, which reduces the need for investing in high-speed lines and lowers support costs.

Creating user accounts is easy. With the administrative interface, you can delineate user rights including the level of Web surfing abilities, file sharing rights, and intranet access. Access for Internet applications such as FTP, RealAudio, and chat can be controlled. We would have liked to have the ability to enable or disable particular protocols for specific users rather than the current all-or-nothing approach.

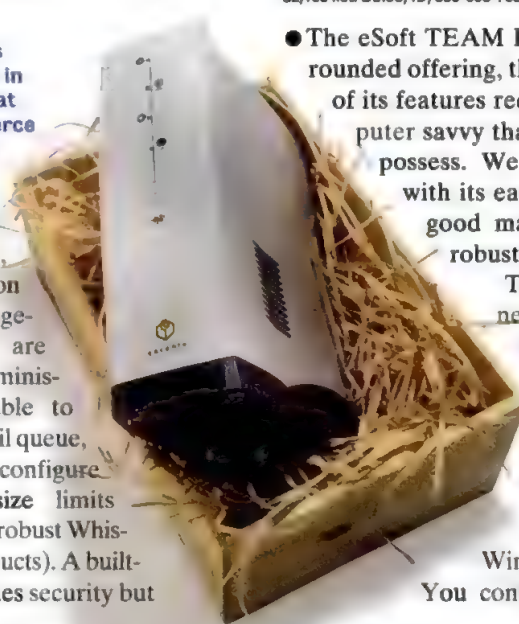
Though the TEAM Internet's initial setup is easy enough for novices, configuration of the e-mail server requires more expertise: You have to enter the e-mail, DNS, and TCP/IP settings manually. We were happy to see, however, that like the Whistle InterJet II Model 2200a, the TEAM Internet supports aliases, distribution lists, and e-mail forwarding. Remote access support requires integration with a third-party VPN server.

Management is a definite strong point. Much like with the Whistle unit, administrators can view the outgoing mail queue, configure spam filtering, and monitor mailbox size by user. System alerts and various types of generated reports help prevent system downtime. —RS

FreeGate OneGate 150

Single Ethernet with V.90 modem, \$2,195 list; dual Ethernet or Ethernet and ISDN with V.90 modem, \$2,995. Sunnyvale, CA; 408-617-1000; www.freegate.com.

● The FreeGate OneGate 150 is easy to install, covers all the basic network services, and enables secure connections between offices. It was one of only two products in this roundup to handle branch-office virtual private networks; and it creates two Web servers by default—one for the Internet and one for an extranet (linked intranets). We would like to have seen the inclusion of





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BENCHMARK TESTS

Internet Servers



These Internet appliances are designed for ease of use, providing Internet connectivity and a range of Internet services to offices too small to have their own dedicated IS staff. They incorporate enhancements not found

in similar but more rugged products (like Windows NT and Linux boxes configured for Internet connectivity). Rather than running our benchmark tests, we focused on how easily someone with minimal networking savvy could configure and maintain these products.

For each product, we set up a network test-bed consisting of two Dell OptiPlex GX1 computers, one running Windows 95 OSR2 and the other running Windows 98, connected via an Ethernet hub. We installed each server appliance to its network according to the vendor's explicit directions, and started with each PC configured as a DHCP client, changing TCP/IP settings only as required by the appliance's setup procedure. To provide Inter-

the IMAP4 e-mail access protocol and some more intuitive content publishing capabilities, but the OneGate 150 is an excellent Web server appliance that out-classes most competitors.

You set up the OneGate 150 network using a workstation and the supplied software. At start-up, it looks for a DHCP server and, if it finds one, obtains an IP address. If not, the OneGate 150 becomes a DHCP server itself. As long as the configuration workstation is using DHCP, the software finds the OneGate 150. Also, it can use a remote management server to download a configuration file. The device comes with a built-in V.90 modem.

Users can publish to the OneGate 150's two Web servers using either FTP or Windows networking. The OneGate 150 shows up in the directory of any Windows net-

work running Windows 95, 98, or NT. Files can be copied to and from the device using any Windows application, but the OneGate 150 won't share files with a Mac. The SMTP/POP3 e-mail server includes mailing-list and auto-reply capabilities but lacks support for the IMAP protocol.

The OneGate 150 comes with a single Ethernet card; a second card is available as part of the ISDN/dual-Ethernet version. For dedicated T1 connections, a separate router is required. Administrators can choose among four firewall configurations, ranging from wide open to totally closed.

The OneGate 150 handles both a remote-access VPN using PPTP and a branch-office VPN using the IPSec protocol. It also accommodates NAT to help leverage a single dynamic IP address. A related product, the OneGate 1000 (\$6,795), supports T1 connections with a

net access to each network, we used the appliance to dial through the public switched telephone network on a single-user account at Concentric Network, a national ISP. If the appliance didn't provide its own modem (as in the cases of Cobalt and Rebel.com), we connected an external modem and then dialed Concentric.

We set up each test network to use NAT—if the appliance supported it—and the single dynamic IP address that we received from Concentric. In most cases, clients were configured for the 192.168.1.0 nonroutable network address scheme, using the appliance's DHCP server to distribute the addresses. If the appliance provided DNS, we configured it with the names of our test network computers and made sure it properly translated the names.

We tested the configuration and dial-on-demand functionality by attempting to browse the Web from one of the client machines. With connectivity established, testing the various services provided by each appliance was relatively straightforward. To test e-mail functionality, we set up each product's SMTP server via its administrative interface, added several e-mail users, and we used the client machines to send e-mail to the accounts. We then retrieved e-mail from these accounts using POP3. We also tested e-mail features like forwarding, vacation messages, and mail lists, as well as whatever discussion group was provided by the appliance.

We created a few Web pages using the page-creation software bundled with the appliance, and then put the pages up on the server. To test appliances as Web servers of Internet content, we navigated our way to the appliances through the Internet, using client machines.—*Analysis written by Russ Iwanchuk*

built-in CSU/DSU, obviating a separate router. In sum, the OneGate 150 is a very good solution for those seeking a flexible, easily configurable Web server.—*RPL*

Rebel.com NetWinder Group Server

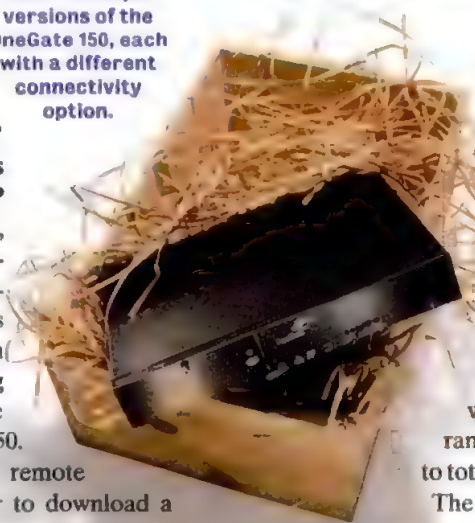
\$1,499 list. Ottawa; 613-788-6000; www.rebel.com.

● The Rebel.com NetWinder Group Server ably handles collaboration and communication tasks, but it has fewer basic networking or connectivity features than the other products reviewed here.

The server includes both Windows and Macintosh file sharing, Web and FTP services, and a content publishing utility called InfoPlace for basic document management. On the communications side, the NetWinder GS boasts a fully functional e-mail server and Web-based discussion groups. But there's no basic network functionality, such as DHCP, DNS, firewall services, and dial-up connectivity to the Internet. It's really just a computer with Red Hat Linux and a poorly designed GUI front end to cover basic configuration.

Initial installation must be accomplished locally and requires that you

FreeGate offers multiple versions of the OneGate 150, each with a different connectivity option.





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Great news. Compaq Computer Corp., supplier of over two million PC servers and the largest provider of multi-user storage in the industry, has joined with Seagate Software, the leading Windows NT storage management supplier, to provide a single, quality solution for all of your information storage management problems. Bundled with every key Compaq ProLiant secondary tape storage device, from entry level to fibre channel enterprise, is a full-functioning, fully integrated 60-day evaluation copy of Seagate Backup Exec and Options. In addition, high-quality Compaq service and support is a single phone call away, 24 hours a day. It's a one-stop solution to help you overcome challenges in this fast-paced world.



SUMMARY OF FEATURES

See www.pcmag.com for interactive views

Thin Internet Servers



	Cobalt Qube 2	Encanto Super e.go 210	eSoft TEAM Internet	FreeGate OneGate 150	Rebel.com Netwinder Group Server	Whistle InterJet II 2200a Network Server	WindDance Breeze
Street price (tested configuration)	\$1,000	\$1,500	\$2,200	\$2,200	\$1,500	\$2,000	\$3,300
CPU	MIPS	Cyrix Media	Pentium/133	AMD 46	SA 110	x86 processor	Intel Celeron
Memory (installed/maximum)	16MB / 64MB	32MB / 32MB	16MB / 16MB	16MB / 64MB	32MB / 32MB	32MB / 32MB	32MB / 64MB
Amount of storage (installed/maximum)	3.2GB / 10.2GB	1.7GB / 1.7GB	3.2GB / 3.2GB	2GB / 6.4GB	6GB / 6GB	3.2GB / 3.2GB	6.4GB / 34GB
Operating system	Linux	Unix	Linux	Modified FreeBSD	Linux	WhistleWare on embedded BSD/Unix	NetBSD
GUI administrative interface	■ (via browser)	■	■	■	■	■ (via browser)	■ (via browser)
Command line interface	■	■	□	□	■	□	□
NETWORK SERVICES							
E-mail client support (POP3 / IMAP4)	■ ■	■ □	■ ■	■ □	■ ■	■ ■	■ ■
FTP server	■	■	■	■	■	■	■
File sharing (Windows/Macintosh/Unix)	■ ■ ■ ■	■ ■ ■ ■	■ □ □ □	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■	■ ■ ■ ■
NAT / DNS / SNMP	■ ■ ■ ■	■ ■ □	■ ■ □ □	■ ■ ■ ■	□ □ □ □	■ ■ □	■ ■ ■ ■
DHCP (server/client)	■ ■	■ ■	■ ■	■ ■	□ □	■ ■	■ □
VPN	Not available	Not available	Optional	Included	Not available	Optional	Not available
LAN/WAN CONNECTIVITY SUPPORT							
Primary Ethernet interface speed	10/100Base-T	10Base-T	10/100Base-T	10/100Base-T	10/100Base-T	10/100Base-T	10/100Base-T
Secondary Ethernet interface speed	10/100Base-T	N/A	10/100Base-T	10/100Base-T	10Base-T	10/100Base-T	10/100Base-T
Built-in router	□	□	■	■	□	■	■
V.90 modem	■	■	■	■	□	■	■
ISDN/Cable	■ ■	□ □	■ ■	■ ■	□ □	■ ■	■ ■
xDSL / T1	■ ■	□ □	■ ■	■ □	□ □	■ ■	■ ■
Frame relay	■	□	■	■	□	■	■

N/A—Not applicable. The product does not have this feature.

attach a monitor and keyboard directly to the NetWinder GS. You then configure TCP/IP and basic parameters using a utility screen; further configuration can be performed through a Web-based utility from any browser on the network. Future versions will support dial-up connections using a built-in V.90 modem, but currently, unless you're comfortable with the Linux shell for serial interface configuration, plan on using external routers.

You can publish to the NetWinder GS using FTP or file copies from Windows or Macintosh computers. Samba, a utility commonly used to let Unix machines access Windows networks, is here used to provide Windows SMB file sharing. Users can take part in both public and private Web-based discussions, though they are not nearly as well organized as with the Cobalt Qube 2.

This product should tap into a lot more of the underlying Linux operating system than it does; most users will want to wait for future versions. But if you really like Linux or only need Web, file, and e-mail services, the current edition of NetWinder GS will suffice.—*RPL*

Whistle InterJet II Model 2200a

\$1,995 list. Foster City, CA; 888-494-4785, 650-577-7000; www.whistle.com.



The Whistle InterJet II Model 2200a proves good things can come in small packages. A superior installation routine, a clean, browser-based interface, and a rich feature set combine to provide a great solution for small workgroups.

This attractive, toaster-size device—replete with a numeric keypad and a small LED display—was the easiest product in this roundup to set up. Using the keypad, you can specify the product's IP address, monitor its system status, and perform other maintenance tasks. During installation, you can choose from a list of Whistle's ISP partners whose settings are impressively auto-configured. Settings for unlisted ISPs can be entered manually.

The InterJet II 2200a offers a wide range of services: Web, FTP, DHCP, configurable firewall/proxy, e-mail, and optional remote-access and VPN support. Cross-platform file serving allows Macin-

tosh and Windows clients to easily drag and drop data to public or private directories on the device. The InterJet 2200a is scalable to ISDN, DSL, cable, and full T1 bandwidths. All the interfaces are built-in: You merely purchase the option and you're provided with an activation key.

The intuitive, browser-based administrative interface is organized by category. Users can be assigned mailbox quotas and be added to mailing lists. They can also forward e-mail or create auto-replies. Basic privileges for remote access or intranet and Web access can be quickly specified.

A configurable firewall lets administrators open specific ports or protocols into the network. You can grant access to various services to a particular IP address or range but not to an individual user. With the optional CyberPatrol Web blocking service (\$395 list), specified users can be prevented from viewing company-deemed inappropriate material.

With the VPN option (\$1,495 for two licenses), you can communicate from one InterJet to another in different branch offices. A Secure Remote Access option

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(\$495) enables remote Macintoshes or PCs to tunnel back over the Internet to the corporate network using PPTP. These add-ons can be activated with a key code.

Creating content is simplified with a 30-day trial version of NetObjects Fusion 4.0. But although the InterJet II 2200a provides a Web counter and a feedback form for CGI scripts, it doesn't support Perl or FrontPage extensions. Several helpful reports give administrators an overview of usage, but they aren't configurable. Various logs for e-mail, Web, and system diagnostics can assist troubleshooting. But unlike the eSoft TEAM Internet, the InterJet II 2200a lacks preventive system-alerting functions.

For those with limited computing expertise, the Whistle InterJet II Model 2200a is a winner. Its superior installation and easy-to-use interface, along with a well-rounded feature set, make it easy to recommend.—RS

WindDance Breeze Network Server

\$3,300 list. Ottawa; 613-728-1700; www.winddance.net.

● The WindDance Breeze Network Server is a little different from the other products in this roundup, offering fax, print, and transparent Web cache services in addition to the usual features. Unfortunately, its Web management interface doesn't provide enough monitoring or status information on the bundled services, and dial-up users need to jump through extra hoops just to get the e-mail server working.

The Breeze NS offers both Windows and Macintosh file sharing, and each user is assigned both a public and a personal folder for storing files. You can create both an intranet and an Internet site. For users who want more (or redundant) storage, other versions are available with either a mirrored hard disk or a single 34MB volume. The WindDance Breeze Internet Gateway (\$1,995) has no fax server and comes with a smaller hard disk (6.4GB).

Included in the Breeze NS is an anonymous FTP server that lets outside users save and retrieve files, but no FTP is available for internal publishing. On the whole, the publishing tools are noticeably lacking. The e-mail server handles POP3, IMAP4, mega-POP (also called multidrop), forwarding,

Custom-Made Web Servers: The Linux Option

Do you've got an old PC going around, and you think you're ready to roll your own server application. Before you start, because you have both a handle on Linux and plenty of networking experience. Otherwise, you'll find yourself spending enough time and resources to pay for a server appliance twice over.

For a Linux server, you'll need a PC with at least 16MB of RAM, a 1GB hard disk, and a network card. There are versions of Linux for a range of platforms.

Commercial versions of Linux have widespread support for third-party network cards, CD-ROM drives, and local devices. But check Linux vendor sites regularly for compatibility with your equipment before choosing a particular version (see www.linux.org for details). While software is great, some commercial time, including the CD and mail and Web servers, but you'll have to solder time with installation and configuration if you go with a commercial version of Linux, such as Caldera OpenLinux or Red Hat Linux.

Q&A at right, each.

The actual Linux installation can be your "make it or break it" step. If you can't get Linux running, then drop it. Here's why this server is a bit. If you get it running, you'll still be missing something that Red Hat's e-commerce features, NetWinder's document management, or the Quake's automated log reporting. But, in many respects, you can download or purchase add-ons to perform these functions, provided you have the Linux know-how to install them.

You must also match the number of licenses with the quantity of your hardware. Because the appliance version of Linux is not a true server, you must install the more services you include, the faster the time to the server and the more hardware needed.

Unless you're an experienced Linux user, don't let your self-love thinking your homebrew 386 solution can compete as smoothly as one of those turnkey boxes. And if Linux is your OS of choice, the sky's the limit.—GA

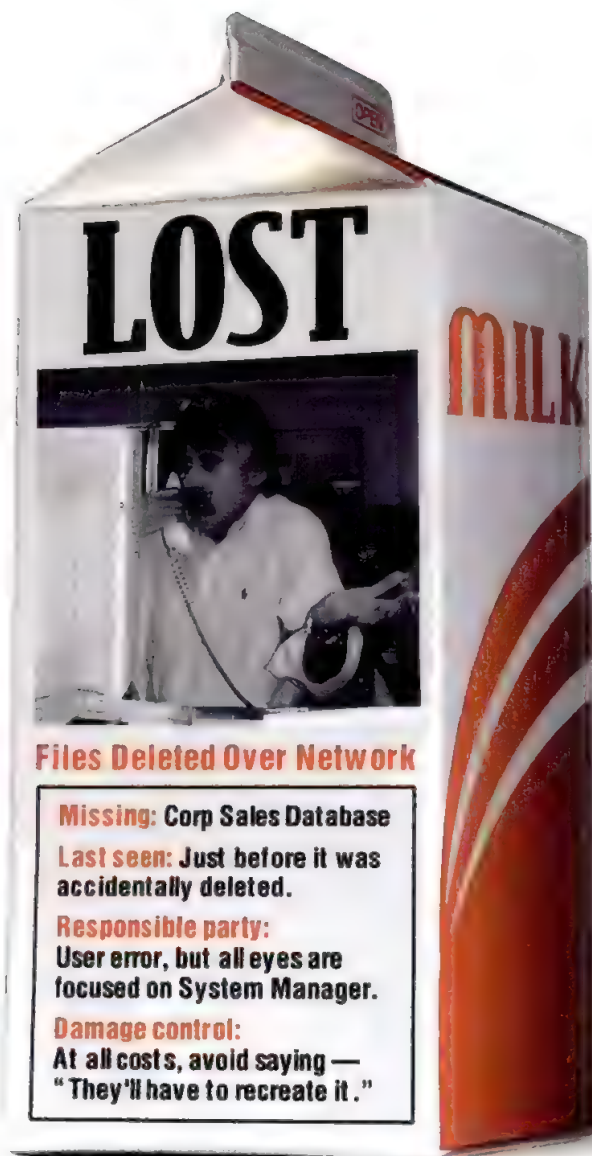


warding, and aliases. We found a bug in the interaction between the Breeze NS's DNS and e-mail that prevented us from receiving e-mail. WindDance suggested a simple (successful) reboot to fix the problem, and WindDance has fixed the problem in new versions.

The product has a built-in DNS server, but it doesn't allow manual DNS entries. Also, it automatically performs network address translation but has no firewall. The transparent Web cache will improve performance, especially for dial-up users with slow connections; it operates like a caching proxy but without the

need to add proxy settings to each user's local browser.

In our labs, we ran into a few problems getting the dial-up link to work, and we couldn't find diagnostic utilities to help. Manual dialing gave us no difficulty, but we encountered intermittent problems with the auto-dial feature. The box would not bring the line up when it was supposed to or take the line down after the 5-minute configured duration. In addition, the Web interface did not accurately reflect the status of the modem during testing, and there was no way to monitor the connection speed.—RPL PC



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Make IE5 Your Own



Here's how both the end user and the systems administrator can take advantage of IE5's copious customization choices.

By Neil Randall

You wouldn't dream of working for hours each day without arranging your office exactly as you like it, so why spend hours each day on the Web without adjusting your browser to your preferences? Although the default options for Microsoft Internet Explorer 5 are a good starting point, you can change a lot of settings—such as how scripts, the cache, or multimedia are handled—to suit your personal working style.

Content providers, service providers, and corporate administrators can even produce a custom version of the browser for distribution over the Web or by CD-ROM. In fact, any version you download will be branded as coming from a particular organization. If you download Explorer from ZDNet, for example, instead of the spinning "e" in the top right-hand corner, you'll see a spinning "ZD" alternating with "Net."

The two primary tools for customizing IE5 are the *Internet Options* dialog and the powerful Internet Explorer Administration Kit (IEAK). After a brief look at the *Options* dialog's major sections, we'll show you how to take advantage of some little-known advanced settings that can save you headaches. And in the sidebar, "Branding Your Internet Explorer 5," you'll learn how to use IEAK to create a custom IE5 version for distribution to multiple desktops.

THE INTERNET OPTIONS MENU

If you run the version of IE5 distributed by Microsoft, you have access to the full set of configuration possibilities offered by the *Internet Options* dialog. Available from the *Tools* menu, this dialog contains six tabs for customizing various IE5 operations: *General*, *Security*, *Content*, *Connections*, *Programs*, and *Advanced*.

The *General* tab is where you change the default home page—the URL that opens when IE5 first launches (yes, you can stop waiting for the slow-loading MSN when you first start). You can also control the behavior of Temporary Internet Files (the cache) and the History list, even deleting this list to keep prying eyes from seeing it.

The powerful *General* tab also lets you select default fonts and colors for sites that do not specify these attributes, and you can customize these even more fully through the *Accessibility* button. This feature lets you completely ignore the fonts and colors that accompany a Web page, using your own (or even an entire CSS stylesheet of your own making) to override the designer's layout. Finally, you can change the language in which IE5 displays dialog boxes and menu commands.

USER TO USER



Remove options from Windows Explorer's *New* menu; unreliable CD-ROM drives; a low-byte alternative to shortcuts; securing private files; overriding WordPerfect's QuickCorrect feature; Excel calculations on the highest few values in a range; limit one combo box's contents based on the choice in another; the Internet Explorer *about:* protocol. *Page 271.*

UTILITIES



Editing the Windows system Registry isn't fun, but it's sometimes unavoidable. Regedit+ makes editing your Registry less of a hassle and a lot safer. It lets you save favorite keys, it keeps a History list of all your changes to the Registry, and it offers multiple undo. *Page 218.*

ENTERPRISE COMPUTING



Enterprise resource planning is a big business that's largely been fueled by the year-2000 imbroglio. But what does the future beyond the turn of the millennium hold for this 5-billion-dollar growth industry? We take a look at uses for ERP systems that go beyond the change of the millennium, focusing on e-commerce, customer-relationship management, supply chain management, and decision support through business intelligence. *Page 219.*

More on the Web:

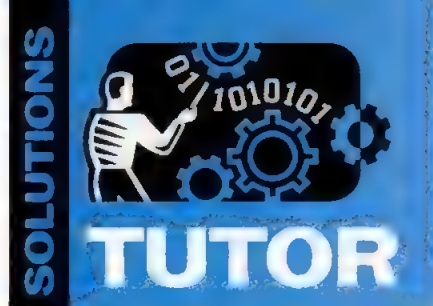
You'll find all of the articles, examples, and code files in this section at PC Tech online.

www.pcmag.com/pctech

Security lets you adjust and restrict the types of sites your browser can access, and the **Content** tab lets you determine how the browser behaves when it encounters site ratings (useful for parental guidance) and digital certificates. This is also where you enter your credit card information and other personal details you're willing to send over the Web. The **Connections** tab lets you establish which dial-in or LAN connection to use with IE5. And the **Programs** tab lets you choose which program to launch when you want to edit an HTML page, or when you click on links for e-mail, newsgroups, or over-the-Net phone calls.

AVERTING ADVANCED ANNOYANCES

The **Advanced** tab is the most powerful and extensive. While we won't even come close to



covering all its options, we'll expose some headache-inducing settings that most people aren't aware of.

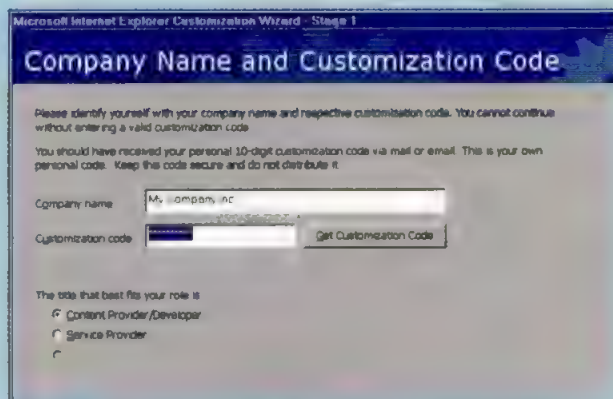
The **Accessibility** settings are designed to help users with visual impairments, but they can be useful to anyone. For example, one of the most annoying browsing experiences is when you choose not to display images and the page layout becomes scrambled. Selecting the option *Always expand ALT text for images* fixes this, keeping a page's layout intact by forcing text boxes to occupy the same space as

they would with images present.

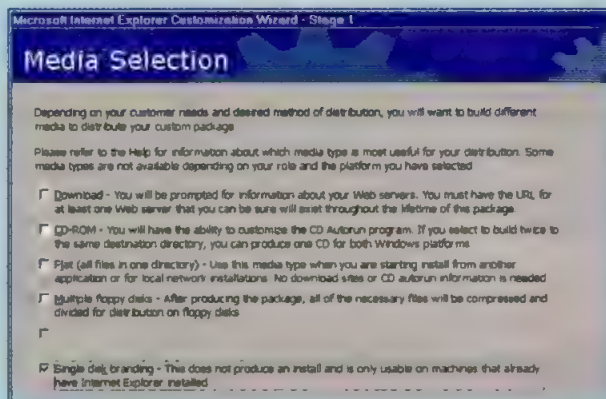
Other helpful settings appear in the **Browsing** section. Checking *Disable script debugging* prevents those pesky script-debugging messages from appearing when IE5 encounters a script it can't execute. The related *Display a notification about every script error* feature not only tells you something is wrong with the script but shows you what the errors are. Again, leave it off unless you're developing and testing your own scripts.

Enable Install on Demand, on by default, is the reason you're repeatedly asked whether you want to download software (such as Macromedia Shockwave) to view the current site properly. These download instructions are part of each IE5 distribution, and if your organization has created a branded version of IE5

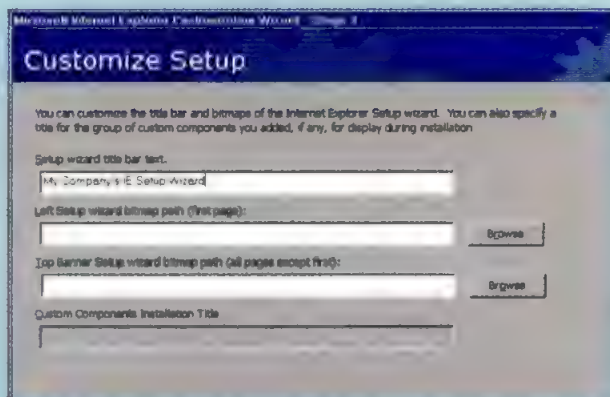
Branding Your Internet Explorer 5



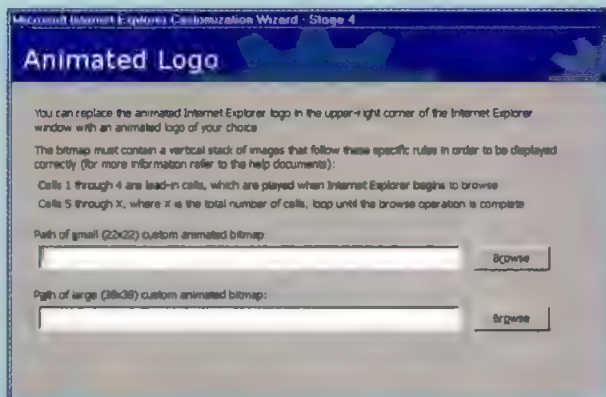
1 You can type any name in the **Company name** field, but the required customization code is assigned when you download IEAK. Without it you can't continue. The next three wizard screens (not shown) are where you choose the platform, file location, and language.



2 The **Media Selection** dialog is where you decide which type of media you want to use for your IE5 distribution. The download site must be a full-time server, but **Flat** is best for LAN installations. Only ISPs can distribute single-disk installations.



5 The **Customize Setup** dialog begins the process of giving your IE5 distribution your own unique stamp, or brand. You can specify the text that will appear on the IE5 title bar as well as the icons that will appear on the user's setup screens.



6 Replacing IE's animated logo is the single most effective branding technique, because most users watch the logo to see whether the browser is communicating. Your images must follow a specific sequence, as this screen notes.

(see "Branding Your Internet Explorer 5"), this feature will be turned on by default and possibly not changeable. In Microsoft's branded IE, however, you can toggle it off—especially useful if you have a slow Internet connection.

Another extremely useful option on the *Advanced* tab is *Launch browser windows in a separate process*. This lets you launch a separate instance of the IE5 program whenever you open a file that IE handles (such as HTML or JPEG) from a program other than the browser itself. For instance, you might click a link in an e-mail message in Eudora. With this option selected, each time you do so a new instance of IE will launch. The benefit: If the content or scripting of one site crashes IE5, you can probably get away with just closing the single offending instance with Ctrl-Alt-

Del. This capability is extremely important when you're doing research and have several sites open simultaneously.

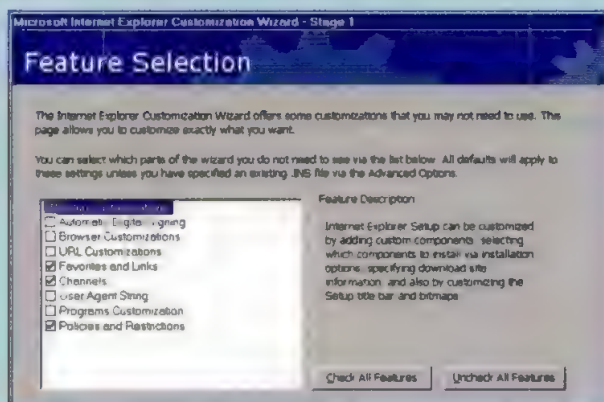
STOP SECURITY SLOWDOWNS

A number of useful and nuisance-saving customizations appear in the *Security* section of the *Advanced* dialog (see Figure 1). One, *Warn if changing between secure and not secure mode*, rids you of the annoying dialog boxes that inform you of this change in your security status. On the other hand, if you've checked the box in the security dialog that offers not to display this information in the future, you can use the *Security* section to turn it back on.

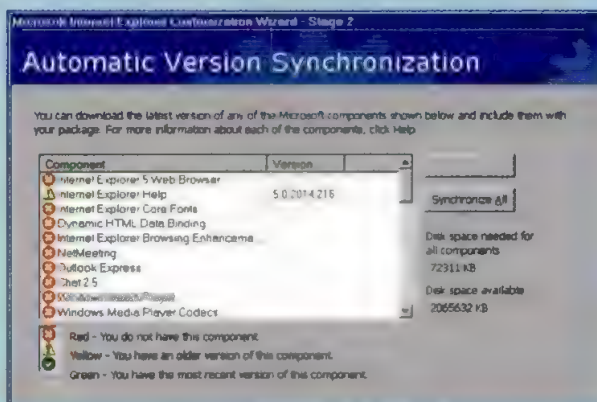
Then there's the option to *Warn if forms submittal is being redirected*, which lets you determine whether IE5 will tell you that the data

from a filled-in form is going to a different address on the Net. Some Web sites use this technique to process forms on separate servers. It's not very unusual for a site to do this, but turning the feature on lets you decide what to do in each case. Use *Fortezza* is a new choice with IE5, but one that is applicable only if you have a Fortezza Crypto Card (www.fortezza-support.com) and are working with the U.S. Department of Defense. If not, you can turn it off with impunity (well, as far as we know).

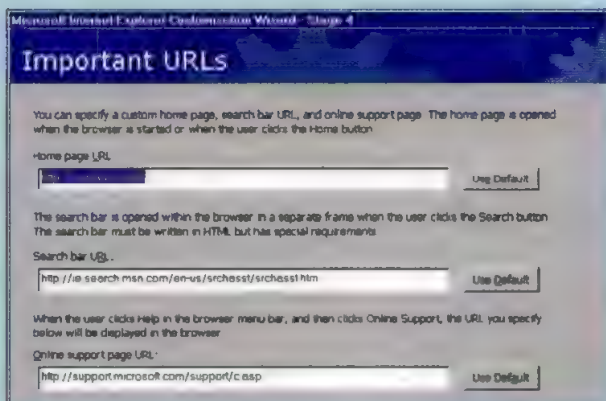
Also available in the *Security* section are two features meant to stop prying eyes from finding your private information. A new option, *Empty Temporary Internet Files folder when browser is closed*, clears IE5's cache of recently viewed documents; this cache, along with the History folder (adjustable from the



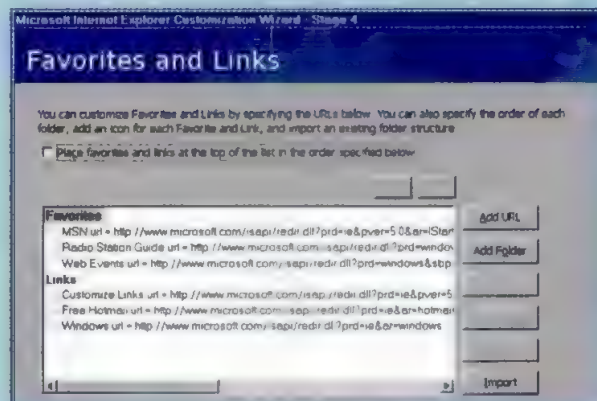
3 Here you choose the features to customize. *Setup Customizations* lets you set download sites and component lists right in the distribution. You can choose logos, title bars, the default home page, the search page, and the support page.



4 This dialog helps you download required IE5 components from Microsoft's Web site. The wizard first scans your directory for version numbers; then it lets you specify which ones to download (*synchronize*), either one at a time or all at once.



7 Another branding technique is to specify the URLs that appear when the user clicks the *Home* or *Search* button or chooses *Online Support* from the *Help* menu. These are easily specified in the *Important URLs* dialog.



8 You can determine what the user will see on the *Links* toolbar or when clicking the *Favorites* button. You can place items in a specific order by using the check box at the top of the dialog, and you can add as many links and favorites as you wish.

General tab) can help your IE performance considerably, but it also leaves tracks others can follow. A related feature is *Do not save encrypted pages to disk*, which tells IE never to cache viewed documents that came into your system in an encrypted state.



YOUR OWN BRAND OF IE

Up to this point, we've looked at ways individuals can customize IE5. If you're an IT administrator or content provider (or ISP), however, you can use Internet Explorer Administration Kit 5.0 to package a fully customized version of IE5 and make it available through download, CD-ROM, floppy disks, or the network.

IEAK's goal is to make all your users' browsers look and perform alike, offering the same appearance, options, and built-in content. Through the IEAK you can *lock down* (Microsoft-ese for *restrict*) such specific items as security zones, proxy servers, remote connections, component upgrades, and installation scripts.

You can also *brand* the version of IE5 you distribute. To find out how to do this, see the sidebar, "Branding Your Internet Explorer 5." The idea behind branding is to customize IE5 so that it presents a version of IE

that's specific to your organization.

You can brand the dialer, for example, so that users will dial into the best possible access number. You can also replace IE's standard revolving-globe icon (at the top-right of the browser) with one of your own, and you can specify background wallpaper for IE's toolbar area. In fact, the IE5 you get from Microsoft is simply a branded and specifically configured IE5, but there's no need to stick with Microsoft's default.

To create a configured and branded IE5 distribution, first download IEAK from the Microsoft site <http://ieak.microsoft.com>. Once you've installed the Administration Kit, launch the Internet Explorer Customization Wizard from the Microsoft IEAK folder in *Start | Programs*.

The wizard is different depending on which of the three titles you choose (see screen 1 in the sidebar): Content Provider/Developer, Service Provider, or Corporate Administrator (the last is accessible only if you license IEAK for internal use). For the demonstration, we used the Content Provider wizard.

Whether you're an end user or head of IT, there are many ways you can make the new version of IE your very own. **PC**

Neil Randall is a contributing editor of PC Magazine.

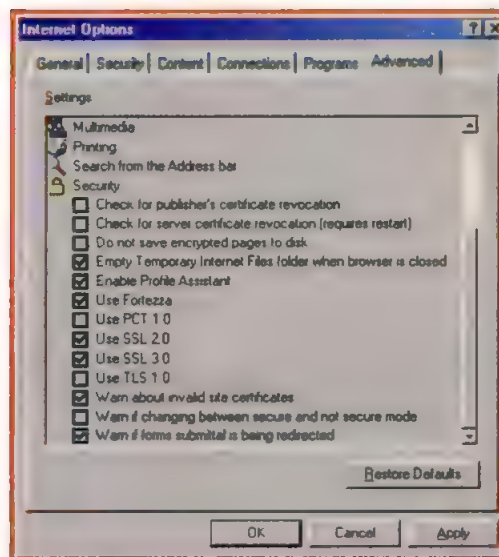


FIGURE 1: The security section of Internet Options' Advanced tab contains several choices that can help avoid nuisance dialogs and prevent snoopers.



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Opinions

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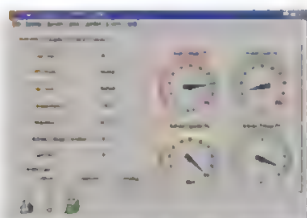


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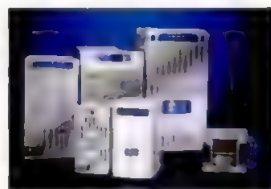
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USER TO USER

Manage Explorer's *New* Menu

In a previous tip ("Clean Up Explorer's *New* Menu," December 15, 1998), you suggested using the Registry to remove items from the *New* menu, which pops up when you right-click the desktop. But there's a much easier way to remove items—and it also gives you the option to restore them. TweakUI has a section specifically for removing items from the *New* menu. Simply uncheck the items you want removed from the *New* menu and they're gone. If you want them back later, just put the checks back.

James Harris
via the Internet

PC The original item explains how to control the *New* menu by editing the Registry directly. Though it's interesting to know exactly how a *New* menu item is defined, editing the Registry using Regedit can be dangerous. TweakUI is decidedly safer. And as Figure

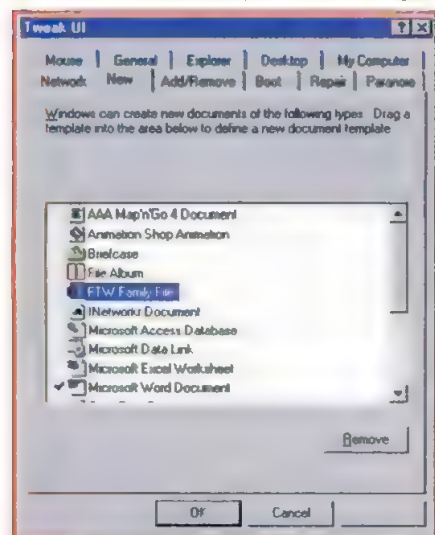


FIGURE 1: The *New* tab in TweakUI lets you specify which programs will appear when you choose *New* from the desktop contextual menu.

1 shows, TweakUI lets you disable or enable an item, totally remove the item, or add a template defining a new item for the *New* menu.

TweakUI is an essential tool for Windows 95 and Windows 98. It comes with Windows 98: If you don't see TweakUI in Control Panel you can install it yourself. Insert the Windows 98 CD and navigate to the tools\reskit\power-toy folder. Right-click the file tweakui.inf, and choose *Install* from the pop-up menu. Windows 95 users can get TweakUI from www.microsoft.com/windows95/downloads. It is part of Microsoft's utility set PowerToys.

—Neil J. Rubenking

CD-ROM Drive Goes on Strike

When I try to access my CD-ROM drive, I get a message reporting that the drive is not accessible. If I open and close the CD-ROM drive, it will start to work again. What could be causing this problem?

Nancy Johnson
via the Internet

PC There are a number of possible sources for this problem. If the drive has trouble reading one or two CDs but reads others without a problem, then check the bottom (clear) side of the disk for smudges or scratches. Wipe them clean with a damp cloth; if there is a severe scratch, you can try polishing it out with a fine abrasive such as toothpaste.

If the problem occurs with all disks, then the drive's read head may need cleaning. Use a standard audio CD cleaning kit; you should be able to find one at just about any electronics or music store. If there is any dust on the head, this should get rid of it and restore your drive to reliable operation.

If none of these solutions work, keep in mind that a replacement CD-ROM drive can cost \$35 or less, even a high-speed 24X model. At these prices, it's probably not worth paying

to repair a broken drive, or even spending a lot of time trying to troubleshoot one that has an intermittent problem.—Alfred Poor

Fast File Access

Most of us make shortcuts for quick access to programs or files we use frequently, but shortcuts take a whole cluster of disk space—up to 32K under FAT16, and still 4K under FAT32. Try this instead. Suppose you often want to read C:\Windows\Tips.txt. Create a new key named Tips.exe below the Registry key HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\App Paths, and set its Default value to C:\Windows\Tips.txt. Now all you have to do is type *tips* in the *Start* menu's *Run* command and you'll see your file. You can do this for any file you use frequently.

Dak Gonzalez
Havana, Cuba

PC Defining a command through the App Paths Registry key uses far less disk space than creating a shortcut, especially on a disk formatted with FAT16. There are other benefits as well, especially if you often use the DOS Prompt window. You can launch a command that has an App Paths entry by entering *start* followed by the program name. For example, on most systems if you enter *wordpad* at the command prompt, you'll get an error message. Try *start wordpad* instead and you'll find it launches correctly, thanks to the Wordpad.exe subkey of the App Paths key.

You can automate the process by creating a Registration Entries file that you can modify to create new commands in the App Paths Registry key. Open a text editor and type the following lines:

```
REGEDIT4
[HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\App Paths\MyCommand.exe]
@="C:\\Program Files\\Program\\Program.exe"
```

Then save the file as Apppath.reg. The file contains three lines (though these may be word-wrapped for display). The first line is simply the word REGEDIT4. The second begins and ends with square brackets. The third line consists of @= followed by a full pathname, surrounded by double quotes, with every backslash doubled.

Load Apppath.reg into Notepad and change MyCommand.exe in the second line to the command name of your choice. Use a simple, memorable name with no spaces. An exten-

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sion is required, but it doesn't have to be .exe, and it isn't restricted to three characters—"PC.Magazine" would be a valid command name. But if the extension is anything but .exe you'll have to enter the entire name, extension and all, to invoke the command. Now change the pathname in the third line to the full pathname of the file you want to launch. This can be an executable or a file of a defined type that's associated with a particular program. Remember that the pathname must be enclosed in double quotes, and that every backslash in the name must be doubled.

Save your modified Apppath.reg and launch it, either by double-clicking it in Explorer or by entering Start Apppath.reg in a DOS window. Once you've done this the new command is available immediately. Enter it in the Start menu's Run dialog, or enter Start and the command name at the DOS prompt.—Neil J. Rubenking

Hardware Solution to Privacy Problem

I have a folder on my system that contains files I don't want others to view. Is there any way to lock this folder so that it would require a password to open the files it contains?

Jim Yates
via the Internet

PC There are a number of shareware and commercial utilities that will add password protection to files on your hard disk; check www.hotfiles.com for some candidates. Those based on PGP are particularly secure. And some word processors, such as Microsoft Word, can lock documents with password-protection features.

The cold, hard fact is that software locks work only at keeping honest people out; anyone who really wants to get at protected content on your system can probably get there eventually. There are tools available on the Web and commercially that can divine the passwords of files saved with standard applications.

So the only way to make certain others can't read the personal files on your computer is to make certain the files aren't on your computer. Save them to a floppy disk—and only to a floppy disk—and lock it away so that others cannot gain physical access to it.

But this still isn't a total guarantee that your sensitive material will remain hidden. Portions or all of your data may also be left in temporary files, in your Windows virtual memory swap file. Some data may also remain in clusters on your hard disk marked as deleted and

available for use by other files, but that have not yet been overwritten. Our utility Shred can help with this problem. When you run this venerable program from a DOS prompt, it overwrites all the free space on your disk. You can get it from www.pcmag.com/downloads.

Some companies are even able to retrieve data from files you have deleted and overwritten. Most casual snoops won't have the time, skill, or resources to go to these lengths to get at your data, but if someone gets hold of your hard disk, your information may be exposed.—Alfred Poor

Override WP's QuickCorrect

When you type the letter c in parentheses, WordPerfect 6.1 changes the entry to a copyright symbol when you press the Spacebar, Tab, or Enter keys. This plays havoc with lists that I need to format using (a), (b), (c), and so on. I have not figured out how to do away with this nuisance, and WordPerfect support at Corel has been no help. Is there a way to solve this problem?

Ed Santo
via the Internet

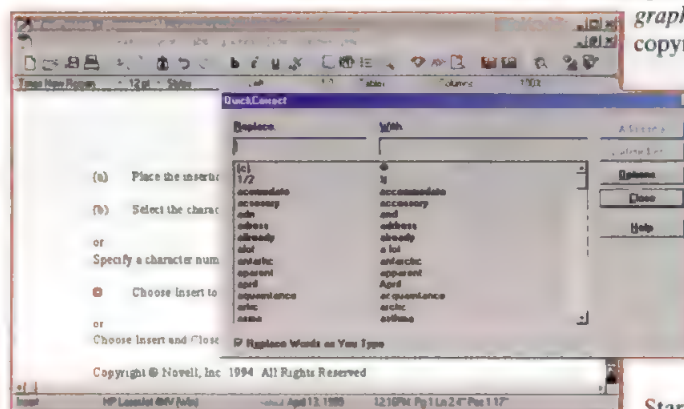


FIGURE 2: WordPerfect's QuickCorrect feature can help you avoid typos, but you may not want to use all of its substitutions.

PC The translation from (c) to the copyright symbol is handled by WordPerfect's QuickCorrect feature, which also corrects common typos, replacing *adn* with *and*, for example. (The concepts here apply almost unmodified to WinWord, too. The feature is called AutoCorrect, not QuickCorrect, but it works the same way.) You can turn WordPerfect's QuickCorrect feature off entirely by choosing Tools | QuickCorrect, removing the

check from the Replace words as you type check box, and choosing Close (see Figure 2).

Unfortunately, turning off QuickCorrect this way also turns off its ability to replace typos as you enter text. If you want to keep the feature active and just get rid of the automatic conversion of (c), however, you can do that too. If you choose Tools | QuickCorrect to open the QuickCorrect dialog box, you'll see two lists lined up under two text boxes labeled Replace and With. The Replace list tells QuickCorrect which words, typos, and abbreviations to replace. The With list tells it what to replace those abbreviations with. Each pair of entries shows on the same line across, with the entries listed alphabetically according to the Replace list.

In WordPerfect 6.1's default list, the (c) and copyright symbol are the first items in the two lists. If you rarely use the copyright symbol, you can select the pair, choose Delete Entry, and answer Yes when WordPerfect asks you to confirm the deletion. From that point on, you'll be able to type (c) without it changing to the copyright symbol even if you've set QuickCorrect to replace words as you type.

If you need to use the copyright symbol occasionally, you can insert it with WordPerfect's Insert | Character command. The symbol is number 23 in the typographic symbols set, which is character set 4. To insert it, you can choose Insert | Character, enter 4,23 in the Number text box, and choose Insert and Close. Or you can choose Insert | Character, open the Character Set drop-down list, choose Typographic Symbols, find the copyright symbol in the Characters list, and then click on it and choose Insert and Close.

You can also add the copyright symbol back to the QuickCorrect list, using an abbreviation that won't create problems when you're not trying to enter it.

Start by inserting the symbol in a document, then select the symbol and choose

Tools | QuickCorrect. WordPerfect will open the QuickCorrect dialog box and automatically insert the copyright symbol in the With text box. Choose an abbreviation that's easy to remember and that you won't need to use in your text; some possibilities are *Cright*, *[cw]*, and *[cw]*. Enter the abbreviation in the Replace text box, choose Add Entry, then Close, and you'll have a custom abbreviation for adding the copyright symbol.—M. David Stone

Only the Highest Spreadsheet Values

I'm trying to develop a grade-marking spreadsheet for my classes to accomplish the following: First, there will be seven columns that contain the following headings: Name, Quiz1, Quiz2, Quiz3, Quiz4, Makeup, and Average. In the Average column, I need a formula that will average only the four highest grades for the tests. If a makeup exam is taken, it must then count as one of the four highest marks and used in the averaging calculation.

Jerry Tobias
Clifton, New Jersey

PC All three major spreadsheet programs have functions that return the *k*th largest and *k*th smallest value in a list. You can use these functions to compute averages or sums based on only some of the values in a list. In Microsoft Excel and Lotus 1-2-3, the function is called **LARGE**. In Quattro Pro, it's **LARGEST**.

An Excel formula that averages the four highest values in B2:F2 might look like this:

```
=AVERAGE(MAX(B2:F2),LARGE(B2:F2,2),  
LARGE(B2:F2,3),LARGE(B2:F2,4))
```

Substitute **@AVG** for **AVERAGE** and **@LARGE** for **LARGE** in 1-2-3. Substitute **@AVG** for **AVERAGE** and **@LARGEST** for **LARGE** in Quattro Pro.

Mr. Tobias wants the average to include his students' makeup scores if they exist, so his formula needs to be slightly more complex. Assuming the four quiz scores are in columns B through E and the makeup score is in column F, and assuming also that the makeup score *must* be included if present, the Excel version of this formula (for row 2) is

```
=IF(ISBLANK(F2),AVERAGE(B2:E2),AVERAGE  
(F2,MAX(B2:E2),LARGE(B2:E2,2),LARGE(B2  
:E2,3)))
```

If F2 is blank, this formula performs a simple average of B2:E2. Otherwise, it averages the four highest values in B2:F2. The equivalent formula in 1-2-3 is

```
@IF(@ISEMPTY(F2),AVG(B2..E2),AVG(F2,MA  
X(B2..E2),LARGE(B2..E2,2),LARGE(B2..E2  
,3)))
```

In Quattro Pro, it's

```
@IF(@ISBLANK(F2),AVG(B2..E2),AVG(F2,MA  
X(B2..E2),LARGEST(B2..E2,2),LARGEST(B2  
..E2,3)))
```

—Craig Stinson

Base One Combo Box On Another

I have a Microsoft Access 97 database that contains **Client** and **Orders** tables. I'm creating a form in which I'd like the user to be able to select a client name in one combo box and have that client's orders appear in another. How can I limit the orders to just those for the selected client?

R. Hemat
Downsview, Ontario,
Canada

PC In order to accomplish this, you should base the **Orders** combo box on a query that matches rows in the **Orders** table with values in the **Client** combo box. Then you must attach code to the appropriate form and control-level events to tell Access to requery the **Orders** combo box whenever the **Client** combo box changes.

Take these steps: First, change the **Name** property for the **Client** combo box to **cboClientID** and the **Name** property for the **Orders** combo box to **cboOrdersID**. This will identify the combo boxes clearly and help eliminate any naming conflicts.

Next, set the **Row Source** property for the **Orders** combo box to a SQL query that matches rows based on the values in the **Client**

combo box. To do this, click on the **Row Source** property, then click on the builder button (the one with the ellipses). In **Query Builder**, choose the columns from the **Orders** table to use in the **Orders** combo box, such as **OrdersID**, **OrdersDate**, and so on, including among them the **ClientID** field. Next, in the **Criteria** row, That tells Access to restrict the query result to just the rows that match the value currently selected in the **Client** combo box. This assumes the bound column in your **Client** combo box is **ClientID**.

When you close the **Query Builder**, Access inserts a SQL statement into the **Row Source**

property and includes in the SQL statement a **Where** clause like the following:

```
WHERE (((Orders.ClientID) =  
[cboClientID]))
```

This restricts the rows to those that match.

Now you need to make sure the **Orders** combo box is properly updated whenever the value in the **Client** box changes. To do this, place the following code in the **Client** combo box's **AfterUpdate** event:

```
Me![cboOrdersID].Requery
```

This tells Access to repopulate the **Orders** combo box whenever the **AfterUpdate** event occurs for the **Client** combo box.

If your form lets you navigate to a different record and by so doing changes the client, you'll want to update the **Orders** combo box whenever the current record changes. To do

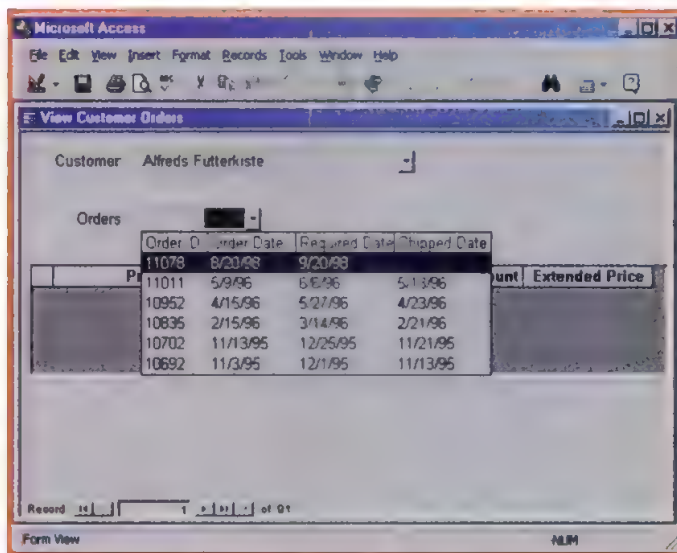


FIGURE 3: When you choose a particular customer from the top combo box in this sample Access form, the choices that appear in the **Orders** combo box below it will reflect your selection.

that, place the same requery code in the form's **Current** event:

```
Me![cboOrdersID].Requery
```

This ensures that the **Orders** combo box is updated properly when you navigate to a different record.

I've created a sample database that demonstrates how to synchronize combo boxes, using data from the Northwind sample database that is included with Access (see Figure 3). Look for the file **Synbox.mdb** in this issue's archive at www.pcmag.com/downloads.

—Sal Ricciardi

Changing Excel Printing Defaults

How can I change the default in Excel 97 to print the entire workbook, not just the active sheet?

Matthew Hanna
Manassas, Virginia

PC Excel is so determined to make Active Sheet(s) its printing default that it does not even maintain your *Print What?* setting when you save a file. Create a file, print the entire workbook, then save and close the workbook. When you reopen, you'll find that Excel is still set to print only the active sheet(s).

You can use a macro with the following command to open the *Print* dialog:

```
Application.Dialogs(xlDialogPrint).Show
```

but the macro will only change a print-dialog setting if you're actually printing something. You can't, for example, simply display the *Print* dialog and then use *SendKeys* to modify the dialog settings, because macro execution is suspended while the dialog is open.

One solution is to create a macro that does print the current entire workbook. Save this macro in your personal macro workbook and assign it the keyboard shortcut Ctrl-P. Then, whenever you want to print the current entire workbook, press Ctrl-P instead of using the menu command.

This approach doesn't change the printing defaults. If you open the *Print* dialog box after running the macro, you'll still find Excel set to print the active sheet(s). But it does save you the trouble of overriding the default every time you want to print the current workbook. Here are the steps:

- From the *Tools* menu, choose *Macro*, then *Record New Macro*.
 - In the *Record Macro* dialog box, specify Ctrl-P as your keyboard shortcut and *Personal Macro Workbook* as the place to store the new macro. Click *OK*.
 - Choose *Print* from the *File* menu. In the *Print* dialog, tell Excel you want to print the entire workbook. Click *OK*.
- Stop the macro recorder.

Because the personal macro workbook (*Personal.xls*) is stored in the *Xlstart* directory, Excel opens it every time you start a session. The file is normally hidden, but the macros it contains are available regardless.

Another approach is to group all your worksheets before you issue the *Print* command. To group your worksheets, click on the page tab for the first worksheet. Then, while holding the Shift key, click on the page tab for your last



worksheet. Excel highlights all the page tabs to indicate that you've grouped the pages. At this point, all the sheets in your workbook are active, so Excel's Active Sheet(s) default prints the whole file. After printing, you can ungroup your sheets by clicking on any sheet tab without pressing Shift. —Craig Stinson

About the About: Protocol

You've no doubt seen the prefixes *http:* and *mailto:* in your browser's address bar, and you may even have seen the less common *ftp:*, *gopher:*, and *telnet:* prefixes. These are protocols that tell your browser what to do with the text that follows. In the case of *http:*, the text that follows the protocol is the name of the Web site you want your browser to display. But there's another nifty protocol you can use: the *about:* custom protocol in Microsoft Internet Explorer.

You may have noticed that if you launch IE and press the *Stop* button before your start page has loaded you see a Web page entitled "Navigation Canceled," and the address bar reads "about:NavigationCanceled." This is an example of Internet Explorer's use of the *about:* protocol. Other predefined Web pages may also be invoked in this way, including such ones as *DesktopItem-NavigationFailure*, *NavigationFailure*, *Offline-Information*, and *PostNotCached*. To see what they look like, simply type, for example, *about:PostNotCached* into the address bar and press Enter.

The trick here is that you can use *about:* for your own purposes. Try typing the following into the address bar:

```
about:This is a <i>very</i> cool test of  
the <b>about:</b> protocol!
```

Press Enter and you'll see the text—with the HTML formatting—in the browser window! You can embed any HTML tags you like into this text, including hyperlinks. Now try typing the following:

```
about:Please visit<br><a href="http://www  
.pcmag.com"></a>
```

Note that the *PC Magazine* logo is a hyperlink, and that it works. This technique also works in Netscape Navigator.

If you're using Internet Explorer, however, you can actually add custom *about:* Web pages to

your system. Labels like *NavigationCanceled* are called monikers, and you can create your own. Suppose you frequently enter a tedious URL such as the following for the Microsoft Office News Service: *www.microsoft.com/office/000/ons/enroll.htm*. Wouldn't it be easier to just type *about:OfficeNews* instead? To do so, launch Regedit, then navigate to the key *HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Internet Explorer\AboutURLs*. In the right-hand pane, you'll see all the *about:* monikers available on your system. To add a new one, select *Edit/New/String Value*. Type *OfficeNews* and press Enter. Then double-click on *OfficeNews* and type (or paste) the URL above into the *Value data* text box. Click on *OK* and exit. Now launch IE and type *about:OfficeNews* into the address bar. Presto!

This is a great way to create an easy-to-remember *about:* moniker that points to your company's intranet site or to your personal home page (called, say, *about:me*). You can even use this technique to "hide" shortcuts to favorite Web sites, since they'll leave no telltale icon in your favorites folder for anyone to see.

Jason Fisher
Dallas

PC Here's an easier (and safer) way to add your own *about:* monikers. Instead of using Regedit directly, create the *Newabout.reg* file shown here:

```
REGEDIT4  
[HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft  
\Internet Explorer\AboutURLs]  
"OfficeNews"="http://www.microsoft.com  
/office/000/ons/enroll.htm"  
"HTMLExample"="about:<h1>TOPIC</h1>  
Line 1<br>Line 2"
```

This file consists of four lines, though some may be word-wrapped in display. The third line creates an *about:* moniker linked to the Microsoft Office News Service URL, as described above. To create your own URL-linked *about:* moniker, simply change "OfficeNews" to the name of your choice and replace the URL shown above with the desired URL. You can create multiple URL-linked *about:* monikers by modifying copies of this line.

The fourth line in the file is an *about:* moniker that displays a simple snippet of HTML code. If you know just a little HTML, you can use this line as a pattern to create *about:* monikers that display useful information, optionally including hyperlinks. Save the modified REG file and double-click on it; you should get a message indicating that the information was successfully entered into the Registry. Now launch IE and try out your new *about:* items! —Neil J. Rubenking



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Safely Edit Your Registry

The Windows Registry holds a huge number of settings. Some can be modified with special-purpose utilities such as TweakUI, but others require you to use the Registry editor, Regedit.exe. The problem: Regedit is as dangerous as it is powerful; it lets you make potentially damaging changes to the Registry without warning you of the effects. It's also tedious to use.

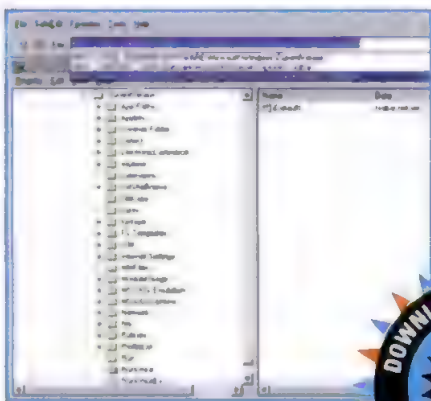
Enter *PC Magazine's* **RegEdit+**, a free utility that takes much of the pain out of Registry editing. (It runs under Windows 95 and 98 but not under Windows NT.) RegEdit+ lets you save favorite

and recently used keys for quick navigation, and the utility gives you multiple-undo capability for Registry changes. It also keeps a running History list of your changes to the Registry.

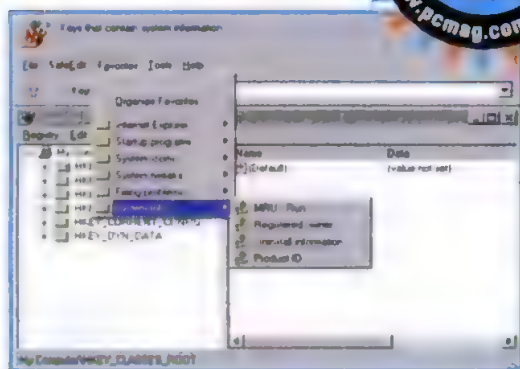
You can download RegEdit+ from our Web site at www.pcmag.com/utilities; there you'll also find an article about how to use the utility and how it was programmed, along with its source code.

Neil J. Rubenking, the author of RegEdit+, is contributing technical editor of *PC Magazine*. Sheryl Canter is the editor of the Utilities column and a contributing editor of *PC Magazine*.

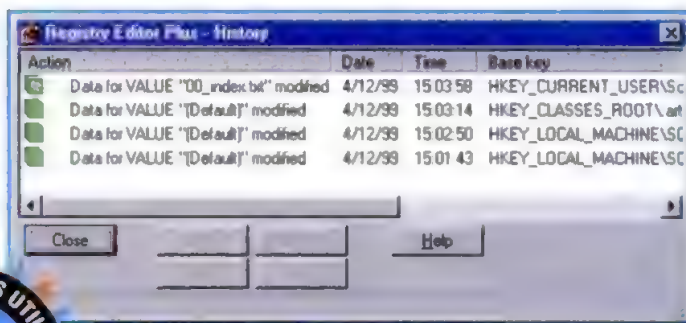
If you enter a name and click on the Down Arrow, RegEdit+ automatically navigates to a recently used key. The Up Arrow saves a key in the list.



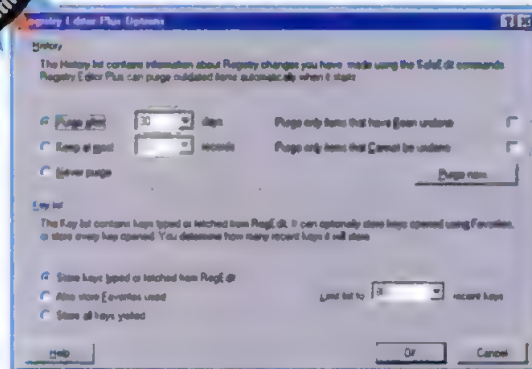
The Favorites menu is pre-configured with useful Registry keys. As you highlight each item, a description appears in the status bar.



Every time you use the SafeEdit functions to change a key, RegEdit+ records the information needed to undo that action.



RegEdit+ can purge History list entries after a specific number of days or limit the list to a specific number of items. Locked items are not purged.



How to Get the Files: PC Magazine utilities and other PC Tech files are available on the Internet and by mail.

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Via Mail: You can request utilities by fax at 978-772-7133 or write to PC Magazine Utilities, c/o Image Software Services, 67 Buena Vista St., Ayer, MA 01432-5030. For disk requests, there is a limit of six per month.

Support: To obtain help for PC Magazine's free utilities, visit our online discussion area on the Internet (www.pcmag.com/utilities/support.html). The authors of current utilities visit this forum regularly. You may find an answer to your question simply by reading the messages posted there. If the author is not available and the sysops can't answer your question, the Utilities column editor will contact the author for you.

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ENTERPRISE COMPUTING

ERP Beyond Y2K

By Rick Freedman

The enterprise resource planning (ERP) market topped \$5 billion in software sales last year and is expected to grow a healthy 35 to 40 percent over the next five years. And this does not include the sales of supporting hardware, software, and consulting services. Healthy, indeed. But with Y2K among the major concerns fueling this growth, we can't help wondering what's going to happen once the clock strikes midnight this December 31. To answer this, let's first take a step back.

Today's ERP systems are an outgrowth of materials requirement planning (MRP) systems, which were developed largely for manufacturing concerns. MRP systems were initially designed to reduce inventory levels by providing an integrated view of supply and demand, measured against on-hand inventory and replenishment lead times. As these systems evolved, they began to incorporate financial controls and measures, master production scheduling, and capacity planning. ERP, in other words, extended the reach of the planning system to include the entire enterprise—everything from management reporting to marketing, sales, distribution, human resources, plant maintenance, and product development. What this translates to is an event-driven, real-time, dynamically balanced enterprise that can continually optimize processes and assets. At least, that's the vision. For many early adopters, however, these systems have yet to realize their full potential.

Over the last few years, most corporations have focused on integrating back- and front-office operations with manufacturing, sales, and distribution. The justification for the original investment was solving the impending Y2K problems, making processes more efficient, and saving money. Now, while costs are down, efficiencies are up, and the infrastructure to support Y2K is firmly in place, it is becoming increasingly apparent that these ERP systems are capable of much more. Most important, they are capable of becoming platforms for real top-line growth.

ERP investment strategies have shifted. Cost reductions and operating efficiencies are no longer the driving forces behind a de-

cision to implement. Revenue growth is the new mantra—and for several reasons. First, globalization has already led many organizations to streamline operational efficiencies, mainly by collapsing traditional operating silos that once compartmentalized organizations—such as disconnected networks, departmental LANs, e-mail systems, and databases. Suddenly, organizations of all sizes recognize that ERP systems can help integrate internal operations.

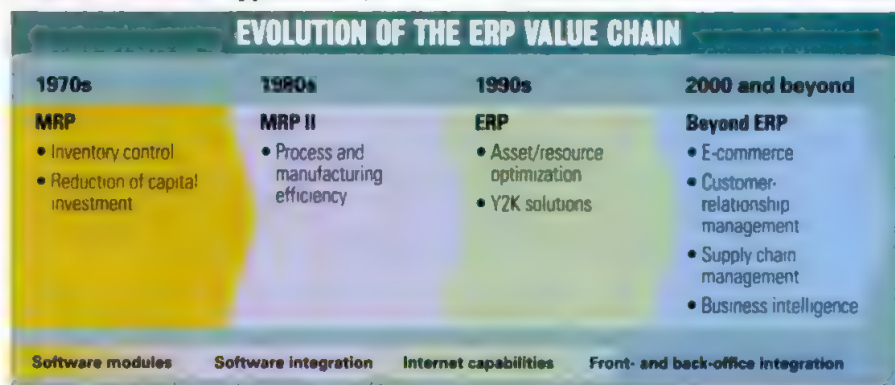
But ERP systems can also help companies reach out beyond the enterprise to their business trading partners and customers, and new technologies keep extending ERP's possibilities. Web-based applications (for the

E-COMMERCE

Depending on whose projection you believe (Forrester Research's or International Data Corp.'s), electronic commerce is expected to grow from \$8 billion in 1997 to anywhere from \$327 to \$400 billion by 2002. E-commerce lets companies reach new markets, operate around the clock, shorten product development cycles, enhance customer service, and more—all at a lower cost.

With the new technologies available today, and those under development, organizations can extend their enterprises by bringing suppliers and vendors into a seamless communications loop for business-to-business interactions that go beyond simple data interchange. More and more, customers are included in the loop. E-commerce makes visible all the supply and demand points across the value chain: When a customer wants a product or service, an online order triggers a series of complex and tightly integrated real-time transactions that fulfill the request, from materials procurement through manufacturing to shipping.

Products and services that are available



Internet, intranets, and extranets) and telecommunications allow virtually seamless, almost real-time integration with suppliers, vendors—and even customers. The internal focus of the past, mainly on making business more efficient, is too limiting for modern enterprises. With increased competition and the broad acceptance of technology as a business driver, IT investments must include components that will either immediately or eventually embrace new, innovative market opportunities. Where should these types of investments be made?

Several IT initiatives stand out. Among the most promising for achieving revenue growth are e-commerce, which includes Internet business applications that affect employees and knowledge sharing, customer-relationship management, and supply chain management. Let's take a look at each area to see why it is so promising.

online will likely be presented via electronic catalogs, and they will affect the way we do business on both the business and consumer sides. Operationally, online procurement will empower employees, reduce production development time frames, increase efficiency, and quicken time to market, while slashing transaction costs. For consumers, round-the-clock access to products and services as well as the power to help develop and tailor the products they seek will foster increased customer satisfaction, and in turn, increased retention rates—which brings us to the next initiative.

CUSTOMER-RELATIONSHIP MANAGEMENT

It seems almost too simple to say, but customer satisfaction and retention are the only real measures of success. You either have happy customers or you don't. Customer-relationship management (CRM) systems are

designed to bring you closer to your customers, so you can serve them better, anticipate their needs, react more quickly, and focus more on what they value. And more important, CRM solutions enable corporations to measure more effectively the value of their exchanges with all their business partners and customers. This is so important that customer-care solutions, including call centers and online self-service, now claim more than 20 percent of businesses' IT budgets.

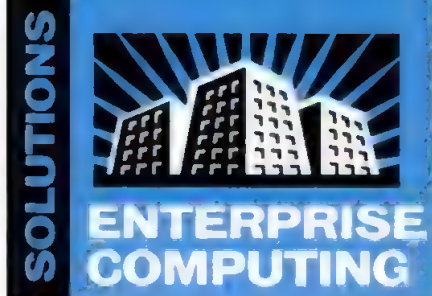
Five years ago, CRM projects dealt largely with automating the sales force. Primary goals of these programs included increasing selling time, decreasing paperwork, and reducing administrative burdens. Today, the scope of these programs extends to include sales, marketing, support, R & D, finance management, channel partners, and even customers, with the goal being increased effectiveness.

CRM creates a real-time, interactive feedback loop from your customers to operations, making it possible to forecast, manage, and meet customer expectations accurately and consistently. Through CRM, an organization manages the entire life cycle of its customer relationships, including marketing analysis and planning, customer acquisition and retention, order management, and customer service and support. And for possibly the first time ever, organizations can truly present one face to customers. Whether customers interact with in-store sales representatives, telephone technicians, the product manager, or call-center operators, all information is gathered and stored in one central system to give the company the opportunity to serve customers better. Perhaps more to the point, this centralized information lets companies better identify new revenue growth opportunities.

SUPPLY CHAIN MANAGEMENT

In the coming years, it may not be companies that compete so much as their supply chains. Finding an organization that can provide products and services faster and cheaper means finding one that best manages its materials, information, cash, and work processes. Supply chain management is a strategic imperative for accomplishing these goals.

A competitive advantage often comes from cutting time to market or production costs. In the global economy, companies partner with other organizations to improve their coverage of international markets and take advantage of lower labor and delivery costs in certain markets. It's all about creating the *interenterprise*,



linking the entire supply chain from the supplier's supplier to the customer's customer.

Supply chain management solutions incorporate all of the steps and processes involved with serving customers and fulfilling their needs. By integrating each functional area into a comprehensive strategy, organizations can address the key issues of cost, speed, complexity, flexibility of response, and customer needs.

Although revenue should be the real driving force behind every business initiative (and the ERP platform is an ideal enabler), other efficiency initiatives will continue to play an important role in a successful business, most

ing, investigate alternate career opportunities, and essentially make themselves ready for meaningful changes as well.

BUSINESS INTELLIGENCE

The heaps of data you collect—on your customers, your operations, your competitors, your products, your employees—don't mean much if they're not easily transformed into meaningful information. Business intelligence helps executives enhance shareholder value by integrating strategic operational and financial data, from both internal and external sources, creating a robust decision-support tool.

Information warehouses provide ready access to multiple databases on multiple platforms across the enterprise. With up-to-the-minute facts and figures, executives have a strong foundation on which to base decisions and can use scenario modeling to validate those

decisions. For instance, with business intelligence, organizations can evaluate merger/acquisition scenarios, analyze the effects of shortening product development lead time, or review customer satisfaction through a reconfiguration of the supply chain.

With business intelligence solutions, you can quickly identify your strengths, pinpoint weaknesses, uncover new opportunities, capitalize on trends, and plan accordingly. And you can combine historical and predictive views of your company's performance with informa-

tion about financial and nonfinancial drivers of business. The idea is to get the right information to the right people at the right time, as well as the answers you need to the questions that matter most—answers backed by collective enterprise fact, not opinion.

Although the year 2000—and consequently the Y2K problem—will soon pass, many organizations are seeing not an end but a beginning. They are discovering that ERP solutions are platforms for real growth, the ideal technological backbones for a multitude of applications that can help businesses run more efficiently and harvest that efficiency for growth. The challenge is to invest wisely in software. Choose the ERP package that best meets your business's needs; the hardware, from the right servers to the right clients; the bolt-ons that address unique industry issues; and finally, the Internet enabling technologies that can let ERP achieve its full potential for the enterprise. **PC**

Rick Freedman is a partner with Ernst & Young LLP in the Systems Integration/ERP Consulting Services practice.



notably effective HR management.

An effective human resource management system does more than just handle typical HR needs, such as payroll, benefits coordination, recruitment, and employee-record maintenance. The combination of an enterprise view and Internet business solutions, for example, is directing an important shift in HR away from purely administrative functions toward asset reallocation and optimization.

Human resource management solutions, such as intranet-based learning and employee benefits self-service, give corporations the ability to gather and disseminate valuable information about and to their employees. Companies can mine their ERP systems for information on employee skills to determine the best way to deploy their workforces. From vast repositories of information, organizations can make strategic business decisions based on the availability and readiness of their people. With this functionality, HR can play a role in making the organization ready for meaningful changes. Likewise, employee self-service programs let employees direct their own benefits, submit changes, structure train-

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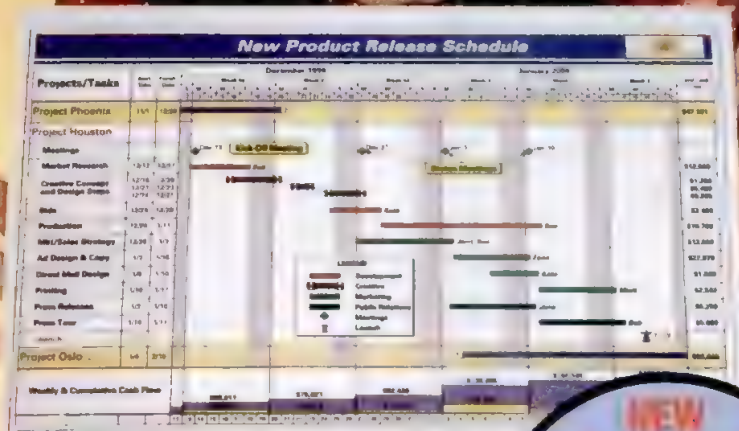
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Publisher's Announcement, 11/98

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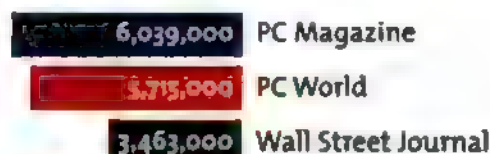


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{ Refer to headline }*

In 1998, cable advertising revenue grew by \$1.2 billion from previous years, and it's expected that in 1999 revenues will increase another \$1 billion.

{ Refer to headline }*

During last year's NCTA convention, more than 29,000 attendees discovered the cutting-edge changes taking place in the cable television industry.

{ Refer to headline }*

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{ Refer to headline }*

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old LPs you've got lying around. (You don't still own a turntable, do you?)

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T786	17" Flat Tube 16" Viewable	1600 x 1200 .25mm Pixel		\$309
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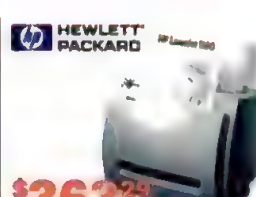
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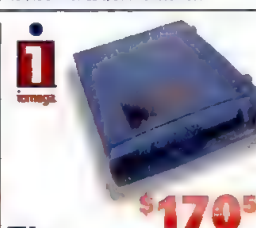
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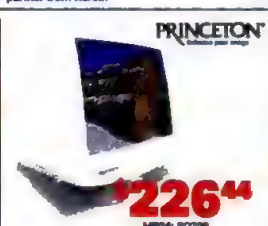
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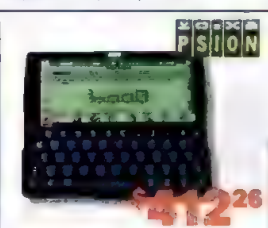
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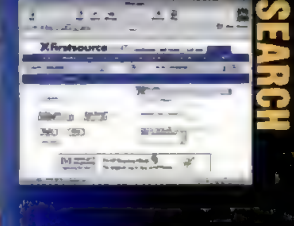
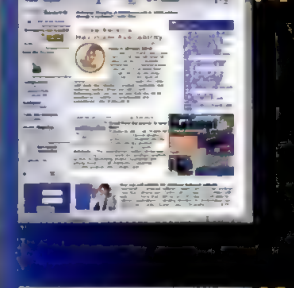
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366 Celeron 64MB 4GB 10/100 NT	1064.68
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HP Vectra VLI Series small form factor desktops	
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400 PII 64MB 4GB 32X	1414.55
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350 PII 32MB 4GB 10/100 NT	1185.7
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3020CT 300MMX 32MB 6GB 10.4" AM NT	2049.59
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ThinkPad notebooks	
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600E 300 PII 32MB 4GB 13.3" AM 24X	2788.78
600E 300 PII 64MB 6GB 13.3" AM DVD	3595.85
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600E 366 PII 64MB 6GB 13.3" AM NT	3797.67
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3500 333 PII 32MB 4GB 13.3" AM 95	2897.77
3500 333 PII 32MB 4GB 13.3" AM NT	2988.28
3500 366 PII 64MB 6GB 13.3" AM 95	3589.69
3500 366 PII 64MB 6GB 13.3" AM NT	3687.97
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E360 333/Pii 64MB 6.4GB 13.3" AM 95	2458.78
E360 333/Pii 64MB 6.4GB 13.3" AM 98	2458.78
E370 366/Pii 64MB 6.4GB 13.3" AM 95	2938.88
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720TX 300/Pii 64MB 6GB 13.3" AM 24X	2339.88
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AM = active-matrix display; DS = dual-scan display

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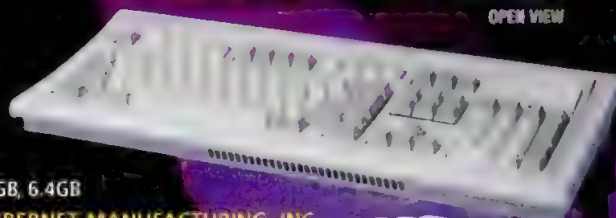
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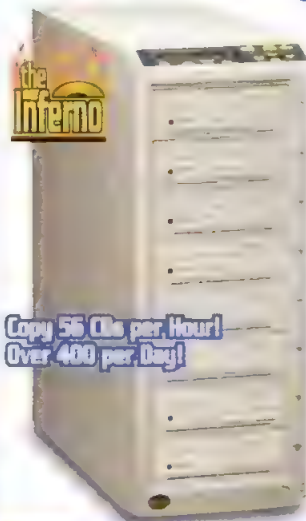
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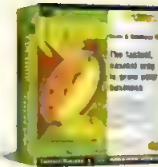
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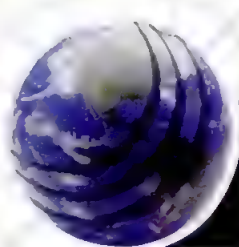
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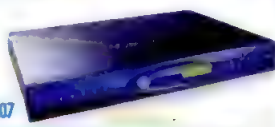
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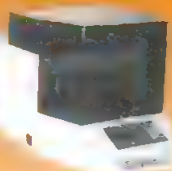
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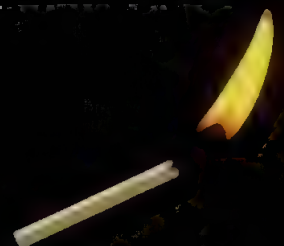
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AFTERHOURS

THE HOME SIDE OF COMPUTING



LOW-COST DIGITAL CAMERAS

Picture This

By Sally Wiener Grotta and Daniel Grotta

You might think it's time to retire your 35-mm point-and-shoot camera because of the new generation of 2-megapixel digital cameras just hitting the market. But they're expensive, they're complicated, and they can be overkill if you just want to print snapshots. In that case, you should check out the new crop of low-end VGA digital cameras. These devices let you quickly and easily output snapshot-size prints from your PC, shoot stills for screen-based presentations, and even post pictures of Baby's first

steps instantly for friends and relatives to view on the Web.

FALLING COSTS

Prices have fallen so far and fast in the digital camera market this past year that we're now seeing entry-level VGA-quality (640-by-480) digital cameras, which sold last year for \$400 to \$700, plummet to the \$150 to \$300 range.

Here we looked at a trio of VGA digital cameras typical of the genre—the Largan Lmini 350 (\$150 street), the Agfa ePhoto 780 (\$250), and the Polaroid PhotoMax PDC 640FL

(\$290). Others are due out next holiday season from such companies as Casio, Toshiba, and Vivitar. To help you decide whether one of these devices suits your shooting style, we compared ergonomics, features, download capability, and handling. We evaluated image quality on a computer monitor and with photo-quality print output from an Epson Stylus Photo EX ink jet printer.

Except for some minor cosmetic differences, the black Agfa and silver Polaroid are physically quite similar—both are large and boxy-looking—with similar LCD panels, control panels, and video out. They part company in firmware, software, and accessories. The Largan is a smart, stylish device (available in six colors!) with rounded edges, and it's small enough to fit in your shirt pocket.

READY TO GO

All three cameras are ready for action right out of the box. The Agfa and the Polaroid come with four double-A alkaline batteries apiece; the Largan includes a single 3V lithium ion battery. Alkalines are a convenience that allows you to try out a camera for a few frames, but you'll immediately want to invest \$20 in rechargeables. A lithium, which costs \$7 to \$9, is good for about 120 shots, half of which are taken with the flash, or 200 with no flash. That's almost three times as many shots

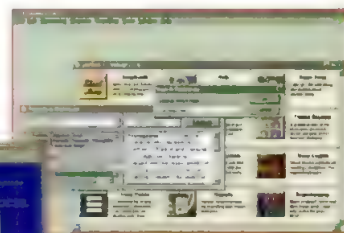
as you'll get with the alkaline batteries in the Agfa or in the Polaroid.

Each of these cameras comes equipped with 2MB of storage memory. The Agfa and Polaroid each ship with a 2MB SmartMedia card (and can accommodate optional 4MB, 8MB, 16MB, or 32MB cards at \$3 to \$7 per megabyte).

Because of firmware differences, the Agfa's two compression/resolution modes can capture 11, 23, 35, or 95 frames on a 2MB card (the fewer the frames the higher the image quality). The Polaroid, on the other hand, records 12, 24, 36, or 96 images. The Largan has only two compression settings, for a total of 30 or 61 images.

POINT AND SHOOT

The process of taking your first shot is neither obvious nor intuitive, because none of the cameras have recognizable on/off switches. To turn on the Agfa ePhoto 780 or Polaroid PhotoMax PDC 640FL, simply slide the protective cover aside to expose the lens. The Largan Lmini 350's combination on/off switch, protective cover, and electronic flash flips up over the camera. The first time you power up the Agfa or Polaroid you're asked to set the date,



WRITING ASSISTANTS

Whether you've run out of plot ideas or need help finishing that screenplay, there's software designed to get those creative juices flowing. *Page 257.*

AFTER HOURS

which requires a look at the documentation.

The Agfa comes with a spartan fold out instruction sheet (in six languages) that tersely explains the camera's various functions, controls, and icons. Polaroid, on the other hand, provides an excellent, illustrated 34-page booklet that's only in English.

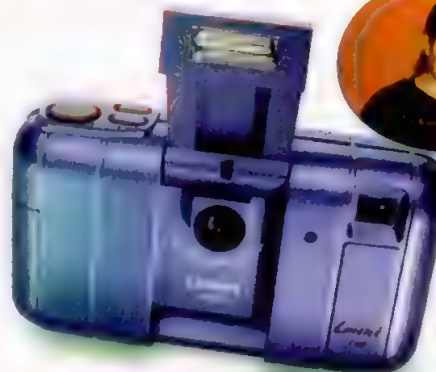
Despite its broken English, the Largan's 15-page documentation will help you navigate the camera's limited functions: The Largan lacks a time/date stamp, and the camera does not present any information along with each frame, such as the

run out of storage space or battery power (whichever comes first). But the Largan recycles in about 13 seconds.

In addition, the Largan's shutter button has hair-trigger sensitivity, so all you have to do is touch it lightly and it fires. By contrast, both the Agfa and Polaroid require slight pressure, as do most electronic shutters, protecting you from taking unwanted pictures.

The Agfa and Polaroid cameras each have a total of ten operational buttons and switches with which to

set image quality, flash mode, the self-timer, focus, and playback on the LCD, as well as to delete or protect images (prevents an image from accidental deletion). There's no auto-focus lens, so you have to move a slider to the macro, portrait, or faraway setting. Unfortunately,



accurate framing and close-up shots. The cameras' shutters have a nice feel and give a satisfying audible click whenever you take a picture.

By contrast, the Largan Lmini 350 is a study in stark simplicity. The unit has only three buttons: shutter, mode, and select. The only controls are flash (on, off, or auto), compression (Hi and Standard), a self-timer, and delete, as well as a feature that indicates pictures remaining or pictures taken. The camera has no LCD and, with a fixed-focus lens, no macro capability either. Worse, the shutter's hair-trigger sensitivity can result in accidental jars to the power switch/protective flap/flash while an image is processing: You'll instantly lose the picture.



the viewfinder doesn't indicate the lens setting (though a macro or portrait icon displays on the tiny control panel at the top of the camera), as we discovered when we shot an entire memory card filled with out-of-focus images.

You can set up the LCDs on the Agfa and the Polaroid as regular viewfinders to display each just-shot image, or you can turn them off to conserve power. The LCD image is grainy and jerky but useful for



shutter speed or flash mode, both of which the Agfa and Polaroid provide. That's an important downside for those who require a record of, say, when exactly that picture of Junior was taken.

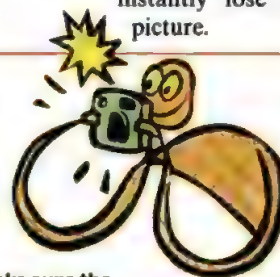
TAKING PICTURES

Here's where we separate the shooters from the snappers, so to speak. Shooters like fast handling and a quick response, which the Agfa and Polaroid cameras provide admirably: Both are ready to shoot 2 seconds after power-up.

The Largan, which is more appropriate for leisurely snappers, takes 12 seconds initially before it enters shooting mode. You can shoot both the Agfa and Polaroid at the rate of about a frame per second, until you

Buying Advice: Digital Cameras

1. For the best selection and prices, go shopping on the Web. Three good places to start are www.computershopper.com, www.photohighway.com, and www.pricewatch.com.
2. If you occasionally take close-ups or pictures of small objects, make sure the camera you buy has macro capability and an LCD viewfinder. These should be standard fare in most digital cameras.
3. Do you shoot action? If so, get a camera with a burst mode of one shot per second or faster. Do you take lots of pictures? Then select a model with removable memory and buy extra memory cards.
4. Though the feature is standard issue on their more costly cousins, few low-cost digital cameras can display images on your TV set. If this feature is important to you, make sure the camera you buy has video-out capability.
5. Digital cameras are notorious for eating lots of power. So purchase a set of rechargeable batteries for around \$20. You will save a lot of money in the long run. You might also want to buy an AC adapter if your camera doesn't come with one. (Not bundling an AC adapter is surprisingly common among many models currently on the market.)
6. Low-cost cameras aren't for everyone. So don't try to stretch your camera's capabilities. If the camera you want can't produce the image size you need, consider investing in a better digital camera, with a higher maximum resolution than the 640-by-480 found in most low-cost models.





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DOWNLOADING

All three cameras can connect to PCs via serial interfaces. The Agfa ePhoto 780's interface features port auto-detect, which automatically determines to which COM port your camera is connected, and the camera has a transfer rate of up to 115 Kbps. Agfa bundles its own decent image-editing software, called PhotoWise.

Instead of a serial cable, Polaroid bundles a floppy disk adapter that lets your computer read SmartMedia cards directly. This is a fast, painless way to acquire images. (The Agfa's floppy disk adapter is optional and costs \$75.) The Polaroid PhotoMax PDC 640FL also comes with its own versatile PhotoMax software.

The Largan Lmini 350's Twain interface is strictly for selecting and acquiring images; the camera lacks a port auto-detect and has a top speed of only 38 Kbps. It comes bundled with Adobe PhotoDeluxe 3.0. Both the Largan and Polaroid digital cameras are equipped with AC adapters for conserving battery power; an adapter for the Agfa costs an extra \$45.

Although the Agfa has the same 350,000-pixel CCD and the same raw capture capability as the Polaroid, Agfa's PhotoWise software incorporates an interpolation-algorithm option that can automatically bump up the resolution to 1,024-by-768, producing a 2.2MB file. (A standard

384MB, we frequently received the cryptic warning *Memory is no enough* (sic). Usually we were able to continue acquiring images by pressing Retry.

IMAGE QUALITY

Viewing screen images and print out-

unwanted artifacts such as stray dots of light.

VGA images generally look better on-screen or on the Web; but again, the size should be limited to about 8 by 10 inches, tops. No VGA camera will satisfy you if you want larger images, more detail, or greater resolution.

The Polaroid yielded the best images but tended toward somewhat cold (bluish) colors. The Agfa's images were detailed but not as sharp, and the colors were warm (yellowish). The Largan's images ranged from fair to awful. With outdoor and nonflash shots, colors were posterized, gradients virtually nonexistent. Flash shots yielded accurate colors, but without exception, any subject closer than 3 feet was blown out.

These results may sound disappointing when compared with the output from more expensive digital cameras. But they are typical of many other VGA digital cameras.

True, these cameras lack the bells, whistles, and high image quality of the sexy 2-megapixel digital cameras just beginning to reach the market. But VGA digital cameras may actually be a better choice (and certainly a less expensive one) when you don't want and can't use higher-resolution image files.

On the other hand, you may be frustrated and disappointed with the limited functionality and image quality of VGA digital cameras. It all depends on the kind of pictures you want to take, as well as how you're planning to display them.

If your appetite is whetted for a digital camera, however, and you're not a camera aficionado, then VGA digital cameras are a good place to start. They are cheap, they're easy to use, and they supply enough functionality for users with basic needs.



uncompressed VGA files is 900K.)

Our tests indicate that the Agfa ePhoto 780 captures more detail and produces slightly sharper images than the Largan Lmini 350 or the Polaroid PhotoMax PDC 640FL. Of course, we loaded the Agfa's JPEG files directly by clicking on the floppy disk adapter.

Acquiring images via the Largan's interface is something of a crapshoot. Even though our test PC was equipped with

put reminded us why the market is shifting toward megapixel digital cameras. VGA image quality was marred by the cameras' relatively limited 640-by-480 resolution. This translates into a maximum print size of 4 by 6 inches, beyond which images become pixelated or display

Preparing Images for the Web

The larger an image file is, the longer it takes to open or download. But if images are too small, you lose detail. The trick is in finding a happy balance between detail and download time. Here are several ways to achieve this.

More meat, less filler. Fill the frame with as much of your subject and as little unnecessary background as possible. That means getting as close to the subject as the camera permits and cropping out anything in the background that isn't essential to the photo you want to take.

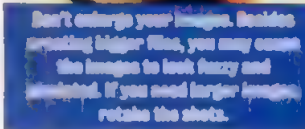
Image size matters. Start by specifying a resolution of 72 dpi (dots per inch) and look at the resulting picture size. The dimensions should be roughly the same size you want to

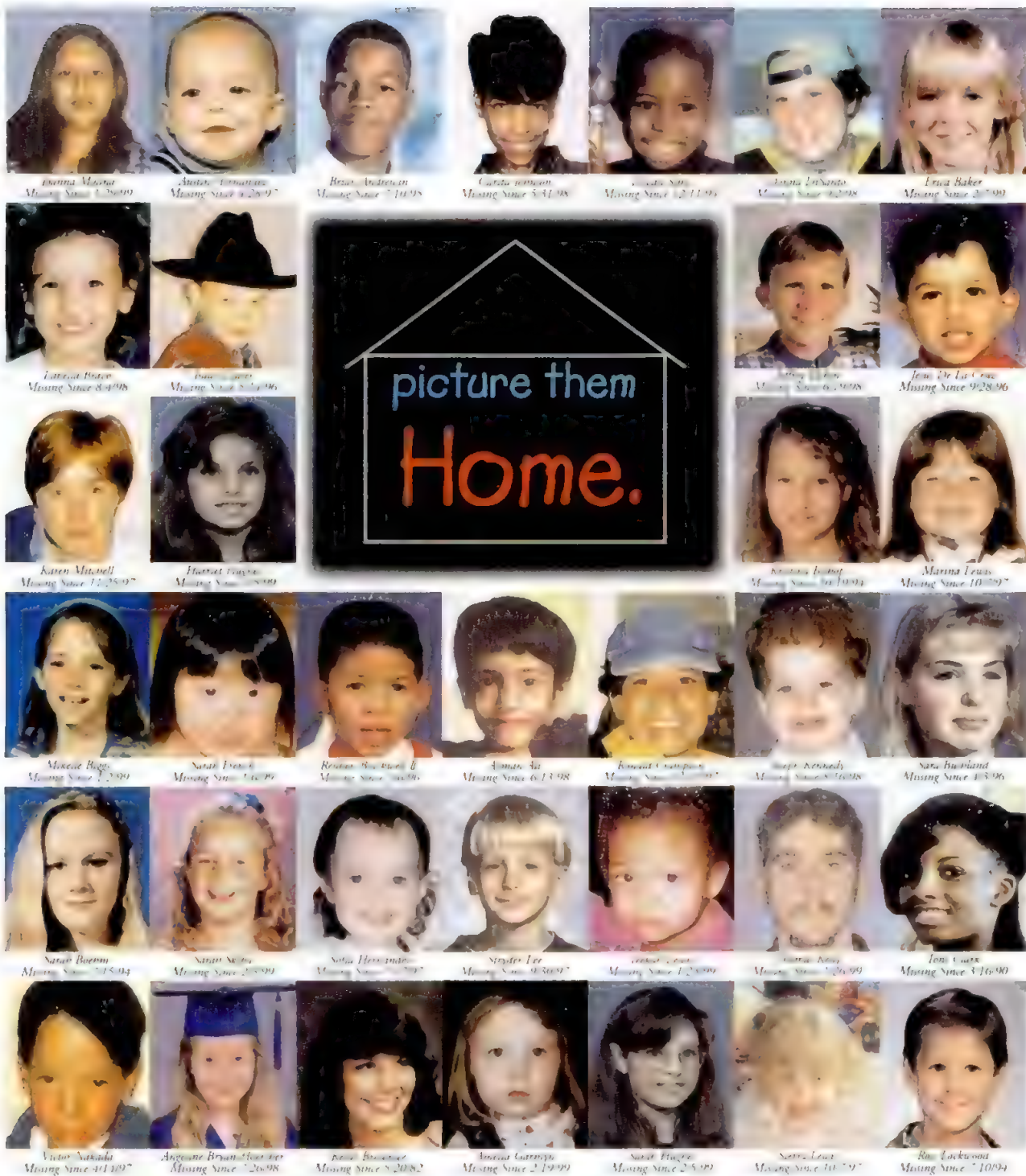
display on-screen—1 by 3 inches, 3 by 5 inches, and so on. As you examine the resized image, be sure to keep your eyes open for any loss of important detail.

Twice is nice. Always save two different files: the original for your archives (in case you need to backtrack) and one specifically prepared for use on the Internet.

Strive for speed. JPEG is the preferred photo file format for the Web. The more you compress the image when saving, the smaller the file and the quicker it'll be to download—but you may lose image quality. We generally like 35K to 40K JPEG files, a size that

balances good image quality with quick downloads, even at 28.8 Kbps.





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AFTER HOURS

CREATIVE-WRITING SOFTWARE

Writing Assistants

By Carol A. Mangis

Creative writing, though ultimately rewarding, is a demanding craft. To paraphrase Tom Clancy, the difference between reality and fiction is that fiction has to make sense. Happily for PC users, a proliferation of software is designed to help you write plays, stories, novels, and screenplays, from first inspiration to final revision.

The programs we looked at range widely in focus and complexity. In some, such as *Dramatica Pro* and *Write a Blockbuster*, you write your story within the program itself or import a story already written, following prescribed steps. Some applications, such as *StoryCraft NT*, merely provide information about the art of story writing, but you compose

independently of the program in your word processor. Still others focus more narrowly on formatting screenplays and creating plots.

Dramatica Pro



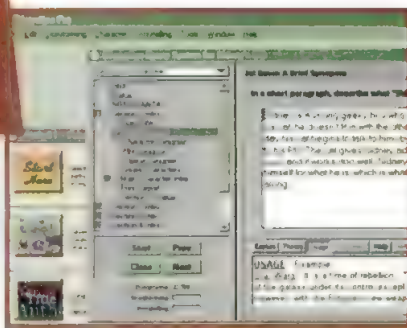
Like screenwriting guru John Truby's program *Write a Blockbuster*, *Dramatica Pro* is a well-developed creative-writing system for the serious writer, and we found it the most fully detailed of the reviewed products. But not everyone will want to take the time to learn to use it, and its high price could prove a deterrent to all but the most dedicated. *Dramatica Pro*'s goal is to ensure that your story will not



miss essential elements that draw readers in; it's especially useful for fixing plot holes and weak characters.

The on-screen Query System takes you through the creation of a story of any length via a question-and-answer approach. Along with the questions are explanations and theory, as well as lots of context-sensitive examples. For instance, a feature called Story Engine tracks the relationships between your characters and your plot; any changes you make are reflected in the rest of your story.

The included manual is detailed, and on-screen help is extensive, with tutorials and the text of a book, *Dramatica: A New Theory of Story*.



Final Draft

Final Draft is a powerful program that makes formatting a professional or would-be professional writer's screenplay, TV episode, or stage play a breeze. It spares you from repeatedly re-typing the same names and slugs.

A tutorial guides you through the basics. After that, the program offers lots of advanced features you can learn as you go. For example, Scene Navigator provides condensed views of your developing script. In addition, there's a useful revisions feature

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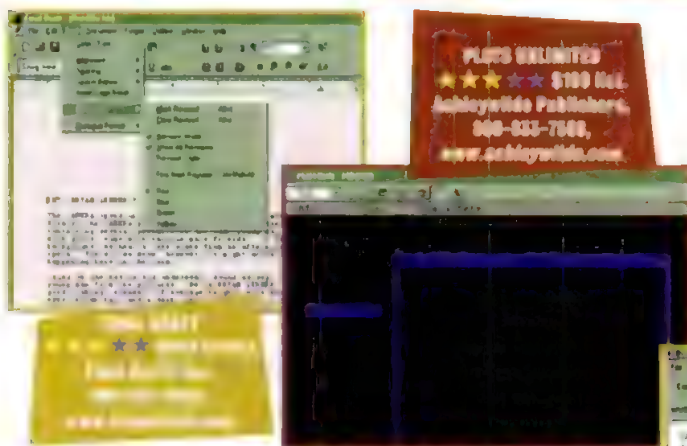
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that lets you track changes by color; collaborators can, for example, turn off one person's red revisions and view another's in blue. (You can also share files between PCs and Macs.)

Final Draft has an intuitive interface, context-sensitive on-screen help, and an extensive 300-page manual. At \$250, Final Draft is worth the investment for prolific playwrights who want to avoid formatting rigors.

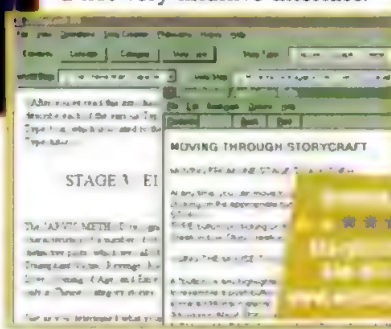
Plots Unlimited

The title says it all: Plots Unlimited. The program won't teach you how to write, but it can help you overcome writer's block or spice up a dreary plot.

Plots Unlimited is a database of more than 5,600 dramatic and comedic situations, plus tools that help you string them into a coherent story line.

You can produce over 200,000 combinations of theme, character, and story.

Budding writers can use Plots Unlimited to whip up a new story or find a fresh twist for a plot that's going nowhere. Then it's up to you to get creative and flesh out the story. The print manual is detailed and clear, guiding you through a not very intuitive interface.



StoryCraft NT

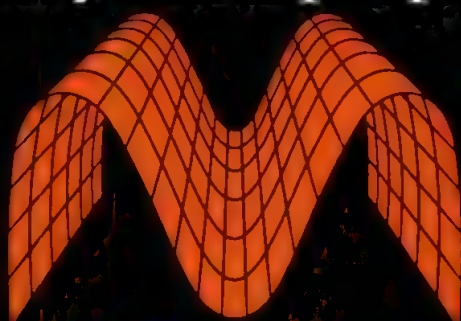
Like Dramatica Pro and Write a Blockbuster, StoryCraft NT is based on a theory of creative

writing: the Jarvis method, which breaks writing down into a step-by-step process. The program contains helpful advice for aspiring writers, though you don't get the detailed instruction rival programs deliver. But StoryCraft is far less complicated to use than they are—and has a much lower price tag.

To use StoryCraft, you read a lesson for each step of story creation, then go to a word processor (your own or the program's) and write. The interface doesn't offer much in the way of interactivity and is a little puzzling initially.

One of StoryCraft's limitations is that its lessons don't address specific genres; they focus on general advice. The program could be right, however, for those who don't want to learn a complicated theory or be led too much through the writing process.

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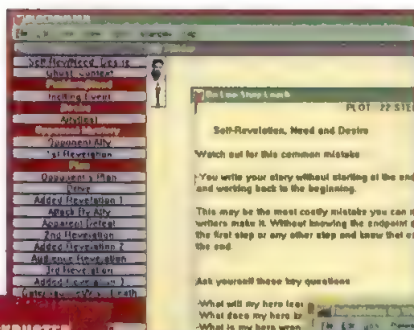
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Write a Blockbuster

Write a Blockbuster, from Truby's Writers Studio, has a huge arsenal of interactive tools to help screenwriters develop and refine their stories. Ideal for new and experienced writers alike, Blockbuster helps you to identify problems in your screenplay and ensure that it works on several levels.

The Quickstory feature helps you get down the essential elements of your script for treatment creation, while Advanced helps you add structure, and Professional helps with theme development.

Professional challenges you to delve into the deepest level of your screenplay's meaning and the characters' motivations. For example, in a module called Arc, you trace the hero's moral fall and eventual rise. Though it wasn't always clear what to write



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for some of the modules, examples proved helpful.

Blockbuster is geared to screenwriting, but there's no reason short-story writers or novelists can't use it. Though not as detailed as Dramatica Pro, at \$100 less this program is a good value.

WritePro, FictionMaster

Beginners daunted by the complexity and price of programs

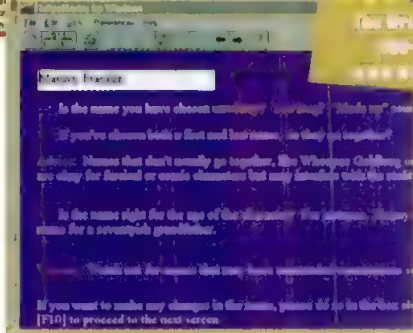
such as Dramatica Pro will do just fine with WritePro, a series of ten tutorials that takes you from character creation to story evaluation and problem solving. You write in the program as you go. Interactive

for the budding writer. For more advanced students, FictionMaster is a logical choice. Instead of sequential lessons you choose from four modules: Characterization, Plotting, Dialogue, and Obstacles. Each contains a couple

of specific topics, such as Avoiding the Autobiography Trap. As with WritePro, lessons are

clearly presented and well thought out, and you write in the program as you go. But in FictionMaster the emphasis is on polishing and finishing your short story or novel via the tutorials.

Though both WritePro and FictionMaster are expensive, they distill a large amount of knowledge about writing into an easy-to-use format. And they're cheaper than classes or private tutors. **PC**



lessons are easy to follow, with plenty of examples. Follow them sequentially and you'll end up with a story.

Of all the programs we tested, WritePro is the best choice

Coming Up

What's in the Next Issue of *PC Magazine*

The Perfect PC

No one PC is right for every user, and the choices you have to make before you buy—processor type and speed, memory size, and peripherals—can be overwhelming. So in this special issue, *PC Magazine's* editors, drawing on experience gained testing hundreds of PCs and peripherals this past year, will explain how to put together the perfect system for a range of buyers: power users, mobile professionals, home users, corporate IT managers, and more. We'll tell you which features to specify when you purchase a machine—and which features you can do without!

We'll also tell you what to consider when building a network for any environment—a workgroup, a department, an enterprise, or even the home: what hardware you need, where to put it, what to do yourself, and what to outsource.

Service and Reliability

Performance isn't the only criterion to evaluate when choosing a system, of course. That's why *PC Magazine* surveys thousands of readers about their satisfaction with the reliability, tech support, and service that vendors provide for their PCs, notebooks, printers, software, and operating systems. We'll also look at user's satisfaction with their ISPs.



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IBM/Cyrix 6x86	PR366	64MB	8GB	17"	\$869.99	(CTQTM23)
AMD K6-2	333MHz	96MB	10GB	17"	\$919.99	(CTQTM26)
AMD K6-2	350MHz	128MB	10GB	17"	\$959.99	(CTQTM35)
AMD K6-2	400MHz	128MB	10GB	17"	\$984.99	(CTQTM37)
Intel Pentium II	400MHz	96MB	10GB	17"	\$1109.99	(CTQTM12)
AMD K6-3 w/256K cache	400MHz	128MB	12GB	17"	\$1219.99	(CTQTM39)
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598 Pre-Assembled Kits: Motherboard in midtower case, 1MB Cache, keyboard, mouse, 56K modem, 1.44MB floppy, and 24X CD-ROM. Sound and AGP video with 8MB onboard.

Tiger 573 Form Factor: AT • CPU: Socket 7 • Bus Speed: Up to 75MHz • OnBoard Video: No • OnBoard Audio: YES • PCI Slots: 4 • ISA Slots: 2 • Memory: 2DIMM/4SIMM • Max Memory: 128/256 MB

Tiger 6KE LX, 68A+ BX Slot 1 With AGP

Motherboard: Motherboard with cable and manual.
Motherboard & Case: Motherboard mounted in dual-cooling fan ATX case; 235 Watt p/s, cable & manual.

FREE FLOPPY DRIVE!
with Item # BB1-C-2D, BB1-T-9A & BB1-T-10A

Tiger 6KE LX Form Factor: ATX • CPU: Slot 1 • Bus Speed: Up to 66 MHz • PCI Slots: 4 • ISA Slots: 3 • Memory: 3 DIMM Sockets • Max Memory: 384 MB
Tiger 68A+ BX Form Factor: ATX • CPU: Slot 1 • Bus Speed: Up to 100MHz • PCI Slots: 5 • ISA Slots: 2 • Memory: 4 DIMM Sockets • Max Memory: 1024 MB

Tiger 5EMA+ ATX Super Socket 7

Motherboard: Motherboard with 1MB Cache; cables, manual

Motherboard & Case: Motherboard mounted in dual-cooling fan ATX case with 1MB Cache; 235-watt p/s, cables, manual

Tiger 5EMA+ Motherboard Features At-A-Glance
Form Factor: ATX • **CPU:** Socket 7 • **Bus Speed:** Up to 100 MHz • **AGP Slots:** 1 • **PCI Slots:** 5 • **ISA Slots:** 2 • **Memory:** 3DIMM Sockets • **Max Memory:** 768MB



Tiger 571 Form Factor: AT • CPU: Socket 7 • Bus Speed: Up to 75MHz • OnBoard Video: PCI Audio: YES • PCI Slots: 4 • ISA Slots: 3 • Memory: 2DIMM/4SIMM • Max Memory: 128/256 MB

Tiger 767 AT, 760 ATX Slot 1

Motherboard & Case: Motherboard mounted in dual-cooling fan case; cables & manual

Pre-Assembled Kits: Motherboard in dual-cooling fan case; keyboard, speakers, mouse, 3D AGP video, 56KFlex faxmodem, 1.44MB floppy, 24X CD-ROM, Wave Table sound

Tiger 767 Form Factor: AT • CPU: Slot 1 • Bus Speed: Up to 100 MHz • OnBoard Video: 8MB AGP • OnBoard Audio: YES • PCI Slots: 4 • ISA Slots: 1 • Memory: DIMM • Max Memory: 768 MB
Tiger 760 Form Factor: Micro ATX • CPU: Slot 1 • Bus Speed: Up to 100MHz • OnBoard Video: 8MB AGP • OnBoard Audio: YES • PCI Slots: 3 • ISA Slots: 1 • Memory: DIMM • Max Memory: 768 MB

MOTHERBOARD SPECIFICATIONS

Motherboard Design	Processors Supported
Tiger 571 AT including Wave Table sound and PCI video	AMD Up to K6-300 & K62-266 Intel Pentium up to 233 MMX IBM/Cyrix up to PR300
Tiger 573 AT including Wave Table sound	AMD Up to K6-300 & K62-266 IBM/Cyrix up to PR300; Intel Pentium up to 233 MMX
Tiger 598 AT including 1MB Cache, Wave Table sound and PCI video	AMD Up to K6-2/450; K63-400 Intel Pentium up to 233 MMX IBM/Cyrix up to PR366
Tiger 5EMA+ Super Socket 7 1MB Cache	AMD Up to K6-2/450; K63-400 Intel Pentium up to 233 MMX IBM/Cyrix up to MII 366
Tiger 767 AT Slot 1 with Sound & AGP video	Celeron up to 433MHz Intel Pentium III up to 500MHz
Tiger 760 Micro-ATX Slot 1 w/Sound & AGP video	Celeron up to 433MHz Intel Pentium III up to 500MHz
Tiger 6KE LX ATX Slot 1	Celeron up to 433MHz Intel Pentium III up to 333MHz
Tiger 68A+ BX ATX Slot 1	Celeron up to 433MHz Intel Pentium III up to 550MHz

MOTHERBOARD ONLY

Item No.	1-2 units	3-5 units	6+ units
MB1-C-1B	\$75.99	\$70.99	\$65.99
MB1-E-8A	\$49.99	\$44.99	\$39.99
MB1-E-9A	\$82.99	\$79.99	\$75.99
MB1-T-7B	\$74.99	\$72.99	\$69.99
MB1-E-5A	\$97.99	\$95.99	\$91.99
MB1-E-6A	\$36.99	\$34.99	\$31.99
MB1-T-10A	\$42.99	\$40.99	\$38.99
MB1-T-9B	\$84.99	\$82.99	\$79.99

MOTHERBOARD & CASE

Item No.	1-2 units	3-5 units	6+ units
BB1-C-1B	\$127.99	\$124.99	\$119.99
BB1-E-8A	\$94.99	\$92.99	\$89.99
BB1-E-9A	\$139.99	\$135.99	\$129.99
BB1-C-2D	\$149.99	\$144.99	\$137.99
BB1-E-5A	\$154.99	\$150.99	\$144.99
BB1-E-6A	\$134.99	\$130.99	\$124.99
BB1-T-10A	\$109.99	\$107.99	\$103.99
BB1-T-9A	\$149.99	\$145.99	\$139.99

PRE-ASSEMBLED KITS

Item No.	1-2 units	3-5 units	6+ units
KT1-C-1B	\$209.99	\$203.99	\$195.99
KT1-E-8A	\$164.99	\$161.99	\$157.99
KT1-E-9A	\$234.99	\$226.99	\$216.99
KT1-E-5A	\$239.99	\$235.99	\$229.99
KT1-E-6A	\$234.99	\$227.99	\$222.99

Power Your Motherboard With A Premium Processor!

AMD K6-3 With 3DNow!

Tiger recommends the Super Socket 7 motherboard with these CPUs

AMD K6-2 Processors	1-2 Units	3-5 Units	6 units or more
#CP2-K6-300 300MHz	\$52.99	\$49.99	\$47.99
#CP2-K6-333 333 3DNow!	\$62.99	\$59.99	\$56.99**
#CP2-K6-350 350 3DNow!	\$68.99	\$65.99	\$62.99**
#CP2-K62-400 400 3DNow!	\$99.99	\$94.99	\$89.99*
#CP2-K62-450 450 3DNow!	\$135.99	\$129.99	\$122.99**
#CP2-K63-400 400 3DNow!	\$219.99	\$209.99	\$199.99*
#CP2-K63-450 450 3DNow!	\$267.99	\$249.99	\$239.99*

Pentium & Cyrix MII

Tiger recommends the AT or a Super Socket 7 motherboard with these processors.

Pentium & Cyrix MII	1-2 Units	3-5 Units	6 units or more
#CP2-6X300 MII 300 CPU	\$41.99	\$39.99	\$37.99
#CP2-6X333 MII 333 CPU	\$47.99	\$42.99	\$40.99*
#CP2-6X366 MII 366 CPU	\$72.99	\$69.99	\$65.99*
#CP2-P233 Pentium 233 CPU	\$46.99	\$43.99	\$39.99

Intel Celeron, Pentium II & III Processors

Intel Celeron, Pentium II & III	1-2 Units	3-5 Units	6 units or more
#CP2-CI333 Intel Celeron 333 processor***	\$78.99	\$75.99	\$72.99
#CP2-CI366 Intel Celeron 366 processor***	\$75.99	\$72.99	\$71.99
#CP2-CI400 Intel Celeron 400 processor***	\$119.99	\$115.99	\$109.99
#CP2-CI466 Intel Celeron 466 processor***	\$194.99	\$189.99	\$179.99
#CP2-P2-400 Intel Pentium II 400 processor*	\$199.99	\$189.99	\$179.99
#CP2-P2-450 Intel Pentium II 450 processor*	\$309.99	\$294.99	\$278.99
#CP2-P3-500 Intel Pentium III 500 processor*	\$549.99	\$529.99	\$499.99
#CP2-P3-550 Intel Pentium III 550 processor*	\$839.99	\$799.99	\$759.99

*** Celeron CPUs are socket 370 format and require a fan and adapter (C183-1000) to be used in any slot 1 motherboard.
* Requires 100MHz bus motherboard and Bus PC100 SDRAM Memory. ** Requires 95MHz bus motherboard and Bus PC100 SDRAM. † Requires 60MHz bus motherboard and Bus PC100 SDRAM. ‡ Requires 66MHz bus motherboard and Bus PC100 SDRAM. § Requires 66MHz bus motherboard and Bus PC100 SDRAM. ¶ Requires 66MHz bus motherboard and Bus PC100 SDRAM. ** Requires 95MHz bus motherboard and Bus PC100 SDRAM. † Requires 60MHz bus motherboard and Bus PC100 SDRAM. ‡ Requires 66MHz bus motherboard and Bus PC100 SDRAM. § Requires 66MHz bus motherboard and Bus PC100 SDRAM. ¶ Requires 66MHz bus motherboard and Bus PC100 SDRAM.

1.44MB 3.5" Drives

Item #	Description	1-2	3-5	6+
TC1-6000	Floppy (Beige)	\$19.99	\$17.99	\$15.99
TC1-6000B	Floppy (Black)	\$19.99	\$17.99	\$15.99

Cooling Fan SALE!

Item #	Description	1-2	3-5	6+
C183-1000	Socket 7 Fan	\$4.99	\$3.99	\$3.49
C183-1000 Slot 1 Fan		\$5.99	\$5.49	\$4.99
C183-1000 Celeron Fan/Adapter		\$13.99	\$12.99	\$10.99

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TC1-4000 40X CD-ROM† \$44.99 \$41.99 \$39.99

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A109-1032 56k Faxmodem \$39.99 \$37.99 \$34.99

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Item #	Size	1-2	3-5	6+
TC1-MEM-32	32MB PC100 SDRAM	\$41.99	\$39.99	\$37.99
TC1-MEM-64	64MB PC100 SDRAM	\$70.99	\$76.49	\$74.49
TC1-MEM-128	128MB PC100 SDRAM	\$159.99	\$154.99	\$149.99

Quantum 19GB-209

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Item #	Manufacturer	Size	Units 1-2	3-5	6+
THD-3A	Seagate	3.2GB	\$107.99	\$104.99	\$103.99
THD-6C	Seagate	6.4GB	\$134.99	\$132.99	\$129.99
THD-19Q	Quantum	19.0GB	\$209.99	\$199.99	\$194.99

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Item #	Description	Units 1-2	3-5	6+
CA1-C-1A	AT Case 9-Bay 200-W P/S	\$44.99	\$42.99	\$41.99
CA1-C-2A	ATX Case 6-Bay 235-W P/S	\$59.99	\$54.99	\$51.99
CA1-M-5A	ATX Server 6-Bay 300-W P/S	\$124.99	\$119.99	\$115.99

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The British version of *Cosmopolitan* reports that "U.S. astrologists are convinced that [Bill Gates's] empire and famous sense of business timing are built on astrological advice. The recent decision to release his new iMac computer just after midnight confirmed their suspicions."

Faithful reader Frank Lewis spent six months creating this giant blue-gill sunfish out of discarded CDs. And yes, you can see a few AOL disks in the mix.



DianaMeter

The Diameter counts, as a symbol of grief and mourning, the days since Princess Diana's tragic death on August 31, 1997. (Caveat: Some users have reported crashes with a previous version, but it appears to work in our test environment and the author believes the problems are fixed.) [more info >>](#)

Georg von der Howen

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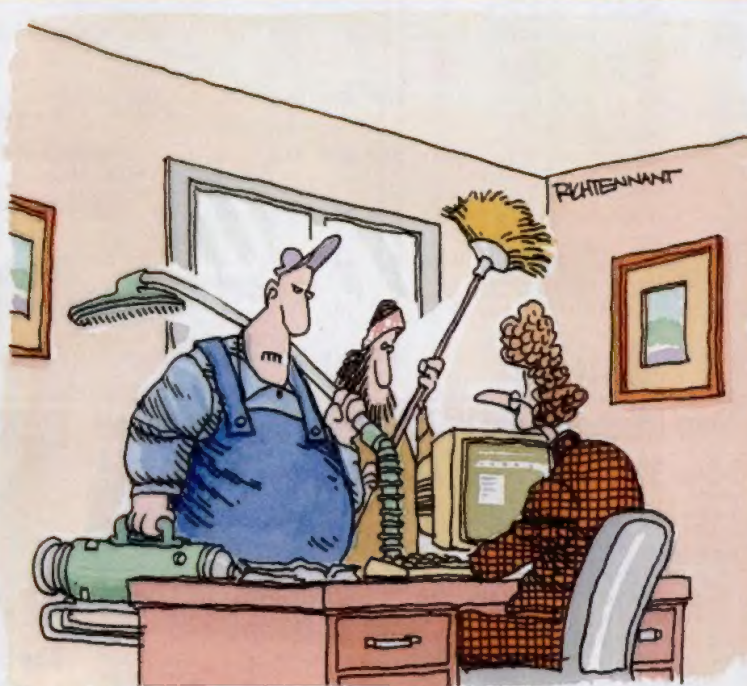
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Grasshopper Gumbo

A note on the Insect recipe Web page of the Department of Entomology at Iowa State University: "[We are] not responsible for gastric distress, allergic reactions, feelings of repulsion, or other problems resulting from the ingestion of foods represented on this page." Foods like banana worm bread and rootworm beetle dip, for example,



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